# NATURE

Vol. 143 SATURDAY, APRIL 22, 1939 No. 3625

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# Research in Africa

IN June next the generous grants of the Rockefeller Foundation to the International Institute of African Languages and Cultures for the promotion of linguistic and anthropological research in Africa will cease ; and the Council of the Institute, it is stated in its annual report for 1938 (*Africa*, **12**, 1 ; 1939), being fully aware of the urgent need not merely of continuing, but also of extending and strengthening this work in every way, now has under consideration its arrangements for the future. These must necessarily depend upon the funds available ; but the wide interests implicated in the vast field to be covered, and the gravity of the issues to which the researches of the Institute contribute understanding, should ensure that financial considerations will not be allowed to cramp its work.

Since 1931, when the scheme of research which is now nearing its final stages was first formulated by the Institute, sixteen full-time research fellowships have been awarded. Of the holders of these, three are still in the field, completing their investigations in Uganda, Nyasaland and Bechuanaland respectively. The remainder, having finished their field work, either have reported or are completing the preparation of their material for publication. These investigators have covered a wide field and have recorded observations of the culture of markedly diverse peoples. Research among African peoples has so vast a range that it may be said that even this organized scheme of investigation has done little more than pass beyond the fringe. Nevertheless, substantial progress has been made. Cultural records have been made among peoples in such widely distributed areas as the Anglo-Egyptian Sudan, Algeria, the Gold Coast, Sierra Leone and Nigeria, Uganda, Kenya, Tanganyika, Nyasaland, Rhodesia, the Transvaal and South Africa.

Further to, and arising out of, these activities in research, discussion among the research fellows and other experts has led to the preparation by the Institute of a symposium on African political organization. This will be edited by Dr. M. Forres, research fellow, and Dr. E. E. Evans-Pritchard.

Obviously discussion of political organization raises many questions with wide ramifications in their bearing on the future of the African. For some time there have been indications here and there of a certain mistrust among the native populations—confined in the main, no doubt, to the more advanced and sophisticated—of both scientific investigation of native institutions and of the relation of indirect rule to such research. It has been alleged, with no small show of confidence, that the aim herein of the white man is "to keep the native in his place"—to stereotype his institutions and to fix his status once for all. If as the result of any discussion or research it should be possible to indicate the lines of a progressive policy of institutional development, adaptable to changing conditions of the day, while avoiding disintegration, it would placate discontent by eliminating ambiguities in the present position.

The linguistic side of research, which has always been a major interest of the Institute, has not been neglected. At the moment, two important works dealing with African languages are in the press ; one on the languages of the Sudan by Dr. A. N. Tucker, based partly on material collected on an expedition financed jointly by the Institute and the School of Oriental Studies of the

University of London, and one on the phonetic structure of the Kikuyu language by the late Miss L. E. Armstrong; while three other linguistic studies are either ready in manuscript form or are in course of preparation.

A further significant development of the Institute's research work, of wider scope than its application to the African field, is concerned with the nutrition of backward peoples—one of the most important subjects to which the attention of research fellows has been directed, if the trend of recent investigation is to be accepted in all its implications. Not only has this matter been under observation by Dr. Audrey Richards among the Bemba of Northern Rhodesia and is now being examined by Dr. Margaret Read among the peoples of Nyasaland; but also the plans for a nutritional field survey, which were drawn up by the Institute with a view to the needs of Africa, have been adopted, with revision and expansion, by an organization set up under the ægis of the Medical Research Council, of which the purpose is the co-ordination of nutritional research work throughout the British Colonial Empire. The nutritional investigation which Dr. Read is carrying out in Nyasaland now forms part of this scheme, which is being conducted under the direction of Dr. B. S. Platt, senior member of the staff for the co-ordination of the research. An ecological survey of Nyasaland is being carried out, in conjunction with the work on nutrition, by an agricultural officer, assisted by forestry and veterinary experts where necessary, the anthropological and sociological side of the investigation being entrusted to Dr. Read. As this is the first survey of the kind under the new organization, it is of particular importance for the development of technique, with a view to future research; while it is of no less notable significance that the socio-anthropological side of this very important question receives due recognition. The Government of Nyasaland has shown that it is fully alive to the value of the inquiry, and has granted every facility to the members of the expedition for their work.

Research such as is too briefly outlined above cannot be financed on a parsimonious scale; and the more closely the problems of Africa are scrutinized, the more evident does it become that future research must be extended to the limits of capacity in resources and personnel. When the results achieved by those who have worked in Africa during the last five or six years on behalf of the Institute of African Languages and Cultures are more fully available, confidence in its competence to continue to direct this work will be more than doubly assured. Further, the methods of investigation which have been followed by many, if not all, of its research fellows have been such that their results not only have conduced notably to the advancement of scientific knowledge, but they are also readily adaptable to the needs of administration, or other provinces of practical affairs. Nor have they failed on occasion to probe weak points in administrative methods, even under indirect rule, where a failure in the understanding, which the anthropologist alone could discern, has led to misinterpretation of custom, mistrust and even friction.

It is further to be noted that both the administration of the Institute's scheme of research and the selection of research fellows have had a marked effect in promoting that international co-operation which, in the eyes of those most competent to judge, is one of the essentials in the future guidance of development in Africa along right lines.

Meanwhile, a word of warning may not be out of place. The interest of African problems at the moment is so insistent, and at the same time so widespread, that there is a very real danger of a dissipation and waste of energy and resources, which could, and should, be concentrated in a single direction of effort to African research. The number of appeals for funds for purposes of research of widely varied character is growing apace, as is the number of organizations, some already in existence, others projected, on behalf of which these appeals are being made. As each one comes forward, it might indeed be considered to strengthen the argument for centralization and the concentration of effort in a single African institute, of which the purpose would be to co-ordinate and direct inquiry, as well as to pool information, and thereby the better to direct suggestion for the application of the results of research to practical ends, while at the same time advancing scientific studies. Not the least of the advantages of such an institute would be the greater weight it would carry, when urging upon authority that the benefits accruing to administration from the results of its researches, and more especially of such anthropological investigations as have been carried out by the Institute of African Languages and Cultures, were of a nature to merit a liberal subvention from public funds, as a return for services rendered or to come.

# Fifty Years Growth of London

History of the London County Council, 1889-1939

By Sir Gwilym Gibbon and Reginald W. Bell. Pp. xxi+696+33 plates. (London: Macmillan and Co., Ltd., 1939.) 21*s*. net.

AT first sight, this comprehensive history of the growth and development of the work of the London County Council to commemorate its jubilee would seem to be an authentic record of significant progress of social and political value. It is not directly concerned with Nature, or the knowledge of Nature commonly called science. Yet much of its nearly 700 pages affords a striking example of the application of science—social science, educational, physical, even biological. We usually associate the familiar name of our local government authority in the Metropolis with the early chairmanship of Lord Rosebery and the enthusiastic band of public-spirited men who gathered round him in 1889, and their not less enthusiastic successors over the fifty years of its history—with their personalities and social ideals, with their programmes and policies and battle slogans, with an improved London and a rising rate. But here is the actual history of their doings and the vast organization which has grown up under their hands.

The size and variety of the activities of the London County Council are in themselves almost bewildering. Two million electors appoint 124 Councillors every three years; eighteen standing committees consist of a dozen to fifty members to deal with the education of 750,000 children and grown-ups in 1,400 schools, with general purposes, with hospitals and medical services, with housing and highways, and parks and open spaces, with public assistance, public control and supplies, with fire brigades, ambulances and main drainage, even with entertainments and recreation. The powers and duties cover all that concerns the life and labour of five million people, living in a metropolitan area which has grown to nearly 116 square miles. Little wonder that its official staff numbers 78,000 persons and its expenditure amounts to £37,000,000 a year. Yet from this vast undertaking there is excluded the control of transport, the provision of water-supply, electricity and gas, and the governance of the port of London, all of which have separate authorities.

When we turn to the application of science, we shall discover many signs of growth and extension. The old London School Board did great things in its day, but after the Education Acts of 1902 and 1903, the whole subject of education fell to the duty of the local authority, and something of a revolution took place. In the first place, all forms and grades of education, elementary, secondary, technical, came under one body, and they were made subservient to each other; then the quality of the teaching has been reformed by particular training of the teacher, and the provision of modern plant and equipment; the physical and mental state of the children has also been greatly improved, by medical and physical care; the special schools have been extended and reformed for defective children; continued education beyond fourteen years of age has been developed, in trade schools, junior technical classes, and evening classes for 260,000 students; the infant schools have been radically amended, and nursery schools for the pre-school child have been established. Particularly has there been great progress in the school medical service, under 20 whole-time medical officers, and 56 part-time officers, with 77 school dentists, added to which there are 250 medical men and 112 dentists at the school clinics and 420 school nurses. There are 18 hospitals in the Council's scheme, and 81 school clinics, treating 315,000 children, and some 900 voluntary care committees with 5,000 members. It is the largest organization of a school medical service in the world, and comprises inspection, treatment, after-care, open-air education, physical training, special schools, child guidance, residential schools and institutions, and indeed everything medical that a sick, or healthy, child can require.

A new departure was made a few years ago in the field of research. The provision made by the Council was so wide that it recognized that the improvement of medical education and research could be facilitated by the better use for scientific purposes of its institutions and laboratories. With the co-operation of the Ministry of Health and the University of London, the Council established a post-graduate medical school at Hammersmith which was opened by King George V in 1935—the first instance of a medical institution created by co-operation between the Government, the county council and the university, which has proved an invaluable service to medical education at the heart of the Empire. Further, Sir Frederick Menzies, the eminent medical officer, has organized a scheme of research work among the hospitals, units, maternity hospitals and special institutions under his charge, and the four special reports on

the work accomplished in 1934–37 indicate an immense sphere of valuable clinical and laboratory research. This also is a unique undertaking for a municipal authority, and reveals an unexpected source of new knowledge. Yet another scientific adaptation has been put into practice in medical education in respect of the training of students in the fever hospitals, for smallpox, and for mental diseases; in the last named, substantial advance has been made in diagnosis and treatment. The mental services of the Council, with 35,000 beds, offer unrivalled opportunities, and these are now being more widely used than has hitherto been the case, in public institutions under local authorities, and especially under the London County Council. Hence new therapeutic, and even preventive methods, are being undertaken in place of mere custodial care.

The application of scientific knowledge by the skilled advisers of the Council has extended even more widely than the sphere of medicine and surgery. This book contains a variety of examples in unexpected quarters, as in the development of the methods of the fire-brigade, the building of the bridges over the Thames, street improvements, the provision of open spaces, slum clearance, the housing estates, main drainage and sewage treatment, flood prevention, even in the unlikely direction of poor relief and public assistance: dietaries, classification and the training and employment of the able-bodied. When science, particularly the scientific method, is applied with knowledge, discrimination and imagination, it is really wonderful what can be achieved to make the public services a scientific, constructive and enduring agency of social reform. G. N.

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# Modern Aspects of Spectroscopy

## (1) Kontinuierliche Spektren

Von Dr. Wolfgang Finkelnburg. (Struktur und Eigenschaften der Materie: eine Monographiensammlung, begründet von M. Born und J. Franck, Herausgegeben von F. Hund und H. Mark, Band 20.) Pp. xi+368. (Berlin: Julius Springer, 1938.) 34.80 gold marks.

## (2) Der Smekal-Raman Effekt

Erganzungsband 1931–1937. Von Prof. Dr. K. W. F. Kohlrausch. (Struktur und Eigenschaften der Materie: eine Monographiensammlung, begründet von M. Born und J. Franck, herausgegeben von F. Hund und H. Mark, Band 19.) Pp. x+288. (Berlin: Julius Springer, 1938.) 25.60 gold marks.

THE series of distinctive yellow-backed volumes published under the general title of "Struktur und Eigenschaften der Materie" have long been known to physicists and physical chemists. The volumes are written by a series of distinguished specialists, and are valuable for their clarity and detailed reference to original papers. The subject of spectroscopy has been well represented in earlier volumes by the work of Stuart, Sponer, Back, Matossi, and Hund. Of the two volumes under review, that of Finkelnburg is an entirely new contribution, that of Kohlrausch being a volume supplementary to vol. 12 of the series. These books reflect, in fact, two important aspects of present-day spectroscopy.

(1) The best-known examples of continuous spectra are those of hot bodies, and Planck's inception of the quantum theory as a result of his work on their radiation properties has perhaps by its very completeness led indirectly to a neglect of other interesting problems in this field. With Dr. Finkelnburg's volume we welcome a book on continuous spectra that is a landmark of its kind, for it is the first volume to treat of continuous spectra as met with in a wide variety of physical and chemical problems. The importance of continuous spectra in such subjects as astrophysics, photochemistry, luminescence, and the technology of lighting is sufficient to give us high hopes of a volume ranging over such widely different fields. One of the pleasing features of the author's treatment is the way in which various items are brought together. We are in the habit of dealing, for example, with such problems as the line spectrum of iron vapour and the continuous spectrum of a hot iron rod as entirely separate; we thus do not easily realize that a study of highly compressed iron vapour would be of particular interest as something intermediate between these two extremes.

"Kontinuierliche Spektren" contains fifteen chapters, the first of which is an introduction to the study of the continuum as it appears in physical and chemical problems, together with some theoretical groundwork. There follows a useful account of the general theory of the electron-continuum, and a chapter on absorption edge continua, and photo-ionization. Five chapters are given up to continua associated with molecules, and good use is made of potential energy diagrams to make clear the various types of absorption and emission continua such as predissociation and

recombination spectra. Chapter x, on the continuous spectra of particular diatomic molecules, including hydrogen, halogens, silver halides, van der Waals molecules ($Hg_2$, $Cd_2$, $Zn_2$), is specially valuable. A good account is also given of line-broadening, and temperature radiation receives due attention. Chapter xiii, on liquids, solutions, and crystals, is the least satisfactory; it is disappointing to find virtually no mention of fluorescence continua in solids. The book concludes with more than seventeen hundred references and a comprehensive index.

(2) Prof. Kohlrausch's book is supplementary to vol. 12 of the series published in 1931. It is divided into eleven chapters, the first five of which form an introduction to the study of the Raman effect. It is, however, for the accumulation of data to be found in the succeeding pages that the book is chiefly valuable. There are sections on molecules containing from two to five atoms, and highly symmetrical molecules with more than five atoms (such as $O_2N.NO_2$ and $SnCl_4$) are also dealt with Hydrocarbon chain and ring compounds are treated separately.

The indexing of a volume of this nature is of great importance. The literature references (more than eight hundred) follow on numerically from those of the earlier volume, and it is possible to search for any compound either under an alphabetically arranged substance index, or under a chemically classified index. In conclusion, one may perhaps express the doubt as to whether it is wise to try and fuse together a text-book and a mass of data in this way. J. T. RANDALL.

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# Vitamins

(1) Vitamins and Vitamin Deficiencies
By Dr. Leslie J. Harris. Vol. 1: Introductory and Historical. Vitamin $B_1$ and Beri-Beri. Pp. xiv + 204. (London: J. and A. Churchill, 1938.) 8*s*. 6*d*.

(2) Ergebnisse der Vitamin- und Hormonforschung
Herausgegeben von L. Ruzicka und W. Stepp. Band 1. Pp. xvi + 470. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1938.) 34 gold marks.

(3) Vitamins in Theory and Practice
By Dr. Leslie J. Harris. Third edition. Pp. xix + 242. (Cambridge: At the University Press, 1938.) 8*s*. 6*d*. net.

THESE three books typify well the existing state of our knowledge in the field of vitamin science and in its applications. The comprehensive and co-ordinated survey of existing knowledge, useful alike to specialist and general practitioner, to chemist, physiologist and medical man, is represented by this, the first volume of Dr. Harris's series of seven projected monographs. At the opposite extreme we have the new edition of the same author's now well-known popular exposition, one of the best examples of a difficult but important technique—that of making scientific facts and hypotheses understood by the layman without sacrifice of truth or clarity.

Perhaps the least successful type of book is that represented by vol. 1 of the new "Ergebnisse". Some of the contributions to it are of a high order, but there seems to have been little planning either in the selection of subjects or in the methods of their presentation. In spite of this criticism—maybe rather a hypercriticism—the book is of considerable value, apart from reference purposes.

(1) If the remaining volumes of this series—a further six are promised in the near future, covering vitamin C and scurvy; vitamin D and rickets; vitamins A and E; pellagra and vitamin $B_2$ complex; other vitamins; applications and dietetics—reach the level of the first, they will inevitably become the standard works of reference on their subjects, especially as Dr. Harris is one of those compilers who seem anaphylactic to out-of-date editions, and will therefore feel the urge to keep all seven volumes in a state of constant revision. It is to be hoped that his publishers will be able to show the same sensibility.

The present volume is an excellent example of what Dr. Harris has set out to do by way of "comprehensive synopsis"—to use his own phrase. In reading it—and it is so readable that the reviewer found not the least difficulty in proceeding 'from cover to cover' in a time of about three hours spread over two days—one has the impression that the author himself has read, and read critically, every paper that has been published on his subject, has evaluated them all and selected for his readers information from those papers only that have contributed significantly to our knowledge. It may be arguable whether this first volume could or could not have more successfully achieved its object; what is beyond dispute is that no one could have made a better job of it than Dr. Harris. Its readers will eagerly await all six of its companions.

(2) The names of the contributors to this volume give it an air of great erudition—and great erudition is to be found in its pages, as well as much speculation of the kind rather more usual in certain parts of Europe than in Great Britain and the United States, at any rate in books of this type. The contrast can be well observed by comparing the authoritative articles of Dr. C. A. Elvehjem (the B-vitamins, apart from aneurine and flavin), of Prof. R. R. Williams (aneurine or thiamin) and of Prof. G. F. Marrian (the œstrogenic hormones) with those of their Continental colleagues. Here, though, one must make the reservation that Dr. T. Reichstein's contribution (the chemistry of 'Cortin') puts him among the English-speaking contributors, in method if not in tongue. The other authors whose names add distinction to the "Ergebnisse" are Profs. von Euler and Glanzmann and Drs. Giroud, Stehle, Berblinger, Guggisberg and Goldberg.

Besides the subjects mentioned above, this volume includes forewords by Sir Frederick Gowland Hopkins and by the editors, Profs. L. Ruzicka and W. Setpp, and articles on vitamin problems in relation to the growing child, vitamin C and its distribution in the living (animal) organism, the hormones of the posterior pituitary gland, 'ergones' and similar constituents of the living cell, the connexion between the pituitary and the reproductive glands, vitamins and reproduction, and the chemistry of the male sex hormones. Authors have been left free to write in English (four contributions), German (six contributions) or French (one contribution).

It is pleasant to welcome so cosmopolitan a volume, especially as it is rumoured that this feature is to be maintained in future volumes of the series. The chief difficulty of the new venture as a whole—new volumes are promised at roughly annual intervals—lies in the rather artificial association of vitamins and hormones, for chemically the connexion is only striking and well established for vitamin D and the steroid hormones of the gonads and the adrenal gland. The natural association, at least for the water-soluble vitamins, seems to be much more with the cellular enzymes, but they have their own "Ergebnisse" already.

The volume is not expensive, considering its size and country of origin, and is well produced, with abundant bibliographical references and an author index. Whatever its defects of conception or execution, it must be on the shelves and in the hands of all workers in the fields covered.

(3) In the gestatory throes of producing "Vitamins and Vitamin Deficiencies", reviewed above, Dr. Harris has yet had time to revise this admirable popular exposition. As well as expressing our astonishment at his energy and its resultant output, we may compliment him on this particular book as symbolizing his realization that science cannot flourish continuously without public support, and that public support depends on public understanding. This little treatise, revised in a few passages to bring the last edition (1937) up to date, can play a valuable part in keeping the public informed and sympathetic.

A. L. BACHARACH.

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# Group Phenomena

## Collective Behavior

By Prof. Richard T. LaPiere. (McGraw-Hill Publications in Sociology.) Pp. xiii + 577. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 24*s*.

THIS work is a fairly comprehensive study of most social interactions in small and large groups. It is equally a contribution to social psychology as to sociology. A large amount of material is discussed that has never hitherto been introduced in books of this type, and the treatment throughout is objective and scientific.

The book is divided into five parts, the first being a general introduction to collective behaviour, the second dealing with cultural types of interaction, the third with recreational types of interaction, the fourth with control types of interaction and the fifth with escape types of interaction. There are copious examples of these various types of social interactions; of institutional, conventional, regimental, formal, nomothetic rebellious behaviour, etc.

Each chapter is, broadly speaking, patterned on the same lines. First there is a qualitative discussion of the specific kind of behaviour concerned, then an analysis in terms of ideologies, membership, overt and covert aspects, and leadership. Moreover, each chapter has a very valuable appendix, giving a critique of sources and bibliography. Indeed, these appendixes are in many ways the most important contribution of the book.

One is particularly struck by the judicious use the author makes of such sources of information and illustration as those provided by newspapers and popular periodicals. This imparts a living,

organic touch to the work as a whole; the subject and treatment never become academic or remote from familiar events.

The method, although the author seems to hope otherwise, is clearly phenomenological, that is, simply descriptive of the phenomena of social life. It has been used most fruitfully by Prof. Katz in animal psychology and human needs and by Prof. Aveling in the study of volitional processes. There is thus no real attempt at a presentation of underlying principles. This is unfortunate and perhaps the chief criticism one has to make. One feels compelled to admit that the subject is still at the descriptive level. But science is far more than a collection of interesting facts sensibly grouped and classified. It requires an economy of explanation, so that much variation is reduced to the workings of few causal forces. In this connexion, one has to deplore the fact that the author nowhere makes any explicit use of psycho-analytic findings, in spite of the fact that psycho-analysis has made notable contributions to this field of study in the works of Freud, Ernest Jones and others. The one reference to the psycho-analytic technique is deprecatory—the meaning of 'symbolism' as used in psycho-analysis "is not clear to any but the disciples of this cult". One reason for this absence of psycho-analytic theory suggests itself, namely, that if the author once commenced with such an approach he would find himself bound to sustain it throughout the work, which would entail acceptance of unconscious processes as fundamental determinants of social behaviour.

Sociologists with an eye for the part of economic conditions controlling the patterns of human behaviour, will find this factor somewhat neglected.

A specific instance where the author takes an extreme position unwarranted by experimental data is in connexion with collective thinking. There is quite inadequate evidence for the statement: "collective solving of any problem is per se a socio-psychological absurdity" (p. 378).

In spite of these defects, the work will be of much use to the student as an introduction to the phenomena of social life. J. I. COHEN.

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# The Present Position of Botany

## Principles of Paleobotany

By William C. Darrah. (Plant Science Books, Vol. 3.) Pp. vi + 239. (Leyden: Chronica Botanica Co., 1939.) 7 guilders; 15*s*.

THEY say the trouble with palæobotany is the number and plasticity of its theories; but these are only symptoms. The real trouble is its facts. To be sure, there are lots which are clearly enough established, but nearly all are incomplete; of the 60,000 fossil plant species which Darrah says have been described, perhaps not more than a dozen or two are known as fully as the fossil botanist can expect to know his material. The result is that nearly everything that can be said in a palæobotanical discussion is of doubtful relevance or equivocal. It is a situation offering splendid opportunities and rewards for research; but for the writing of a fairly short book it is beset with difficulties. However, Dr. Darrah believes in his task, for he writes near the beginning: "From 1885 to 1915 paleobotany underwent its modernization chiefly because of the appearance of the textbooks and reference books".

This book is called in the prospectus "an integrated summary of the present status of Paleobotany" and that does indeed describe it. In a book of this modest length much must be left out, and although every palæobotanist will regret the suppression of some favourite line, the book must be conceded to be well balanced. It appears best when on fairly general topics which fall nearest the title "Principles of Paleobotany" and is certainly least good when it describes, as in the chapters on the Devonian, genus after genus after the manner of an extremely condensed text-book. There are some pleasant little line drawings which help but only illustrate a few of the plants described.

Somewhat more space is given to morphology (and resultant ideas of phylogeny) than to floristics (and ideas of plant migration); but both are dealt with, as also more limited topics like the formation and structure of coal; palæobotanical technique and history.

It should be made clear that this book was written for the unspecialized botanical reader. It is in no way, however, a popularized account; on the contrary the reader is assumed to be painstaking, and the list of relevant literature at the end of each chapter offers him the possibility of weeks of further study. It is a lot to hope for, but the author's enthusiasm is so evident that it may go a long way to inspire equal keenness.

T. M. HARRIS.

**The Sun:**
its Phenomena and Physical Features. By Giorgio Abetti. Translated by Alexandre Zimmermann and Frans Borghouts. Pp. 360. (London: Crosby Lockwood and Son, Ltd., 1938.) 20*s*. net.

IT is a commonplace to refer to the sun as the nearest star, unique in presenting a disk for detailed study and thus deserving the closest of observation. In this book, Dr. Abetti, the director of the Arcetri Solar Observatory at Florence, surveys our knowledge of solar phenomena gained from the rather restricted direct telescopic observations to those embraced by the extensive field of spectroscopy. How rich the results have been may be quickly appreciated by looking through the numerous illustrations. Behind some of these lie years of devoted research and great inventive ability, as in the case of a spectroheliogram of beautiful definition, the detection and measurement of the magnetic field of a sunspot, or the recording of the sun's inner corona without a total eclipse.

Of astronomical readers of the book, the solar observer will perhaps derive the greatest profit and pleasure, because the book is written from his point of view. To the theoretical worker, however, this comprehensive survey will be of use as a reminder (to quote from the prefatory note) "of the existence of a large body of observational material which cries out for investigation by the inductive theorist". During the last few years, there has been a growing body of wireless research workers and others who require information of the sun's behaviour during its 11-year cycle of activity. To these also, Abetti's book can be recommended to answer their questions. It will be surprising if nothing more than a transitory interest is felt after this introduction to a star in action.

**Du pétrole**
Par Victor Forbin. (Ce qu'il faut connaître, 28). Pp. 158. (Paris: Boivin et Cie., 1936.) 8 francs.

THERE is no doubt that M. Victor Forbin in his book "Ce qu'il faut connaître du pétrole" has satisfied a long-felt desire of the 'French layman'. Every intelligent person at some time or other is driven by an urge to find out more about petroleum, that commodity which in an unbelievably short time revolutionized modern standards of living and which is used in some form or other every day by the poorest and richest alike. The development of the petroleum industry has been, and still is, romantic, and there is no reason why its romance should be buried and lost amid chemical formulæ and statistics of text-books comprehensible only to technologists and others directly concerned with the industry.

M. Forbin has written an easily assimilated story of petroleum, but at the same time there are included in it much authentic information and a number of judiciously inserted statistics. There is so much information in this small paper-covered book that it should provide a satisfactory answer to practically all non-technical queries about petroleum and a great many technical ones, whether concerning origin, production, refining or commercial distribution.

**Mosquitoes of the Ethiopian Region**
2: Anophelini; Adults and Early Stages. By the late Dr. Alwen M. Evans. Pp. x+404. (London: British Museum (Natural History), 1938.) 20*s*.

A SHORT time before her death in August 1937 Dr. Alwen Evans brought to London the MS. and drawings for a monograph on the Anophelines of the Ethiopian region. This work was, happily, nearly complete, and has been seen through the press by Dr. F. W. Edwards of the British Museum (Natural History). In rather less than twelve years the number of Anopheline mosquitoes known from the region in question has become about doubled. This increase in knowledge has made the present monograph one of great value and necessity. *Anopheles*, it may be added, is the only genus of these mosquitoes that occurs in Africa, and is represented by the two subgenera *Anopheles sen. str.* and *Myzomyia*. Wherever possible there is included, under each species, a description of the adult insect, the pupa, larva and egg. There follow accounts of the larval habits and breeding places; habits of the adults; relation to malaria; and, finally, distribution.

We have nothing but praise for this comprehensive and scholarly work, which is admirably arranged and clearly illustrated. In every respect it forms a worthy memorial to its author, whose decease, in the midst of an active and scientific life, was a great loss to workers in medical entomology. A. D. I.

**Chemie und Technik der Gegenwart**
Herausgegeben von Dr. H. Carlsohn. Band 18: Feuerfeste Baustoffe: silikatischer und silikathaltiger Massen. Von Dr. Claus Koeppel. Pp. xvi+296. (Leipzig: S. Hirzel, 1938.) 17 gold marks.

THE first part of this book deals with the various modifications of silica (quartz, tridymite and cristobalite) in a very clear and satisfactory manner, the quantitative data being summarized in tables and curves. In the second part, the system silica-alumina is described, followed by the system silica-alumina-lime. The changes of state of silica in refractories owing to changes of temperature and the effects of various other substances are systematically described. The remaining part of the book deals with the effects of silica in other refractories, namely, magnesia, dolomite, natural magnesium silicates, chromite and zirconia.

**Domestic Pests:**
What they Are and How to Remove Them. By L. Hunter. Pp. xii+235. (London: John Bale, Sons and Curnow, Ltd., 1938.) 7*s*. 6*d*. net.

THIS little book is intended to give information regarding the various kinds of animals—from mites and insects to rats and mice—which invade human dwellings. Besides giving accounts of preventive and remedial measures, something is also said about the life-histories of the various creatures likely to be met with. In addition to animal invaders, a short account of the common domestic moulds is also included. The book has been well planned, and its subject-matter is scientifically accurate and well adapted for the purposes intended.

# Structure of Proteins*

By Prof. J. D. Bernal, F.R.S.

THE structure of proteins is the major unsolved problem on the boundary of chemistry and biology to-day. We have not yet found the key to the problem, but in recent years a mass of new evidence and new lines of attack have enabled us to see it in a far more concrete and precise form, and to have some hope that we are near to solving it.

The problem of protein structure is twofold: the first is that of the form and properties of the protein molecule, and the second that of its internal structure. Owing to the extreme instability of the protein molecule, only the gentlest physical methods can be used; nevertheless three lines of attack—centrifugal, electrical, and X-ray—have already led to great success. The most fundamental has been the ultra-centrifuge, particularly the work of Svedberg and his school[1]. Protein molecules will sediment in sufficiently high centrifugal fields, and from their sedimentation constant it is possible to arrive at a fairly accurate value for the weight of the molecule, though there is some doubt as to whether what is measured is that of the complete protein molecule, because of its inevitable association with the solution in which it is suspended.

The most striking discovery of Svedberg was that the weights thus obtained seemed to fall into definite classes which were multiples of each other. This suggests very strongly that all proteins are built from some common unit. What that unit is is more difficult to determine. Originally taken as 35,000, proteins are now found of 17,000 and even of 10,000 molecular weight. Critical examination of the data, moreover, shows that there is no exact correspondence to certain weights, but rather a scattering of weights concentrated in certain regions. There is no doubt that in closely related proteins there are simple relationships. Both hæmoglobins and hæmocyanins can, for example, be split reversibly into 2, 4, or 8 parts. But whether these relationships hold for all proteins is more doubtful; particularly as studies of viscosity have shown that proteins belonging to the same weight class such as insulin and gliadin may differ enormously in shape, the first being a flattened sphere and the other an elongated rod, and it is difficult to see what common physical structure they can have.

* From a Friday evening discourse delivered at the Royal Institution on January 27.

It has been claimed that this variation of weight of proteins of the same Svedberg class is to be expected on account of the known difference in amino-acid content. On the basis of existing analytical figures, it is as yet impossible to say whether this is or is not sufficient to account for the observed discrepancy. The figure of 288 amino-acid residues in a 35,000 molecular weight class protein cannot be taken at present as more than an inspired guess.

The second approach to protein structure comes from the electric properties of their molecules. The work of Cohn, Tiselius, and others gives us a picture of a protein molecule in solution as a particle covered with positive and negative charges due to the acid and basic nature of the amino-acid side-chains. The number of these groups depends on the condition of the medium. The protein molecule is, therefore, in its external relationship an essentially ionic structure, and probably carries with it an ionic atmosphere stretching out into the water in which it is dissolved.

The third line of attack is that of X-ray study. The beautiful crystalline forms exhibited by proteins, which have been known for at least a hundred years, were always a powerful attraction to X-ray crystallographers, but until the last five years the instability of protein crystals and their small size had defeated their efforts. Since 1934, however, it has been possible to examine a number of typical protein crystals[2]. This has been done by mounting them in small tubes in their mother liquor, for most, if not all, proteins suffer considerable breakdown if examined dry. From the beginning, the results of this examination revealed important new facts. In the first place, the pictures yielded by protein crystals were of exceptional perfection. They showed large unit cells with a great wealth of reflections (see accompanying illustration), and these reflections were found even at comparatively high angles corresponding to such low spacings as 2 A. This indicated that not only were the molecules of the proteins substantially identical in shape and size, but also that they had identical and regular internal structures right down to atomic dimensions.

From the size of the unit cells and their densities it was possible to compute the weight of matter in each repeat unit. This, however, does not immediately give the molecular weight, for two reasons. In the first place, the number of molecules

in the cell is not known, and in the second it is difficult to determine how much of the cell weight is due to the protein and how much to the water in the cell. By measuring the loss of water on drying it is, however, possible to arrive at a figure for the—possibly fictitious—dry weight, which can be compared with those obtained by the centrifuge or by chemical means. Here it is found that there is excellent agreement on the assumption that there are only a few, 2, 4, or 8, such molecules per cell[3]. Thus the X-ray method furnishes an extremely accurate measure for the basic molecular weight of proteins though it cannot determine its multiplicity. It may well be that many proteins are built of sub-units, which though of approximately equal weight are not chemically identical, and are more properly to be called molecular compounds than molecules.

The most striking feature of the cell measurements of crystalline proteins is the considerable change which occurs on drying, where in many cases shrinkage of nearly 50 per cent occurs. But what is more remarkable is that the shrinkage is often confined to one or two directions in the cell. There are two possible explanations of this fact. First, that the molecules of the protein are linked together in extremely loose aggregates which collapse on the removal of water, leaving the skeleton of molecules in a now more closely packed array. The other explanation is that the molecules are held apart by their ionic atmospheres due to the charges on them, and contain, therefore, sheets of free water. It may be that both explanations hold, one more markedly for some crystals and the other for others. Thus for hæmoglobin, where there is a marked shrinkage from 55 A. to 38 A. in one direction, it is difficult to imagine an ionic atmosphere, as the crystals are practically salt-free and at an isoelectric point of *p*H 6·8. On the other hand, it is difficult to explain the remarkable properties of tobacco mosaic virus on any other hypothesis. This virus has long thin particles which have a tendency to set equidistant and parallel, even down to concentrations of 13 per cent and probably down to 1·5 per cent. It is difficult to imagine what force other than that of ionic atmospheres can preserve this regularity. Quite recently we have shown that the equilibrium distance between the particles depends on *p*H and salt concentrations, varying, for example, between 320 A. at *p*H 7, and 206 at *p*H 3·4. It should be possible to find a quantitative theory to explain these changes and, indeed, the beginning of such a theory has been made by Langmuir[4] and Levine[5].

The general picture of the external character of protein molecules is beginning to be definite. The molecules are spheroidal bodies of dimensions varying from 30 A. to 100 A., are covered with hydrophil groups bearing charges of both signs, and probably carry with them in solution an atmosphere of ions.

The problem of the internal structure of protein molecules is one of enormously greater difficulty. Any effective picture of protein structure must provide at the same time for the common character of all proteins as exemplified by their many chemical and physical similarities, and for the highly specific nature of each protein type. It is reasonable to believe, though impossible to prove, that the first of these depends on some common arrangement of the amino-acids. The first hint of this comes from a study of the fibrous proteins. Here, owing to their technical importance and their much greater ease of handling, a very considerable advance has been made, due largely to the well-planned and persistent researches of Astbury[6].

The fully extended β-keratin fibre has a strong repeat at every 3·5 A., corresponding to the length of one amino-acid residue, and two other repeats at 10 A. and 4·5 A. respectively, corresponding to periodicities at right angles to the chain length. One of the most significant of Astbury's discoveries was that these two periodicities are also at right angles to each other. In other words, that the repeat unit of the fully extended protein has distinct characters in three dimensions. The significance of these repeats seems also beyond doubt, the 10 A. spacing corresponding to the length of the side-chains of the amino-acid residues, and the 4·5 A. to the so-called backbone spacing between the main chains themselves, which are held together by the CO and NH groups. In the shorter α form, the 10 A. spacing remains, while the 4·5 A. disappears, and this indicates that the chains are folded, but folded definitely in a plane and not as in rubber in two dimensions. What the precise mechanism of this folding is remains obscure, but it is of fundamental importance because it is probably very closely associated with the kind of folding that occurs in the corpuscular proteins.

The significance of these findings for the general protein problem is, first, that all soluble proteins hitherto examined give on denaturation a fibrous material which can be oriented and seems identical in basic structure with β-keratin, and secondly, that the actual change which a crystalline protein undergoes on denaturation must be very slight. This is shown by the close resemblance of powder photographs of crystalline proteins before and after denaturation, and also by the observations of Astbury, Dickinson, and Bailey[7] that a single crystal of excelsin gives on partial denaturation fibres orientated in the direction of the crystal

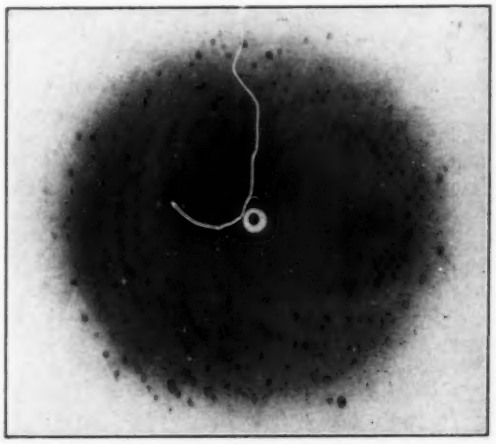
axes. Further, recent work by Perutz[8] has shown by an entirely different method, namely, the study of the absorption spectra in different directions in crystals, that the position of the prosthetic group in hæmoglobin is not altered by denaturation.

The evidence that the X-ray study of the crystalline proteins themselves provides for the elucidation of their structure is abundant, but it is extremely difficult to interpret. Photographs of crystalline proteins (see illustration) show hundreds of spots and marked differences of intensities stretching right out to reflections corresponding to interatomic distances. Unfortunately, however, direct analysis of these photographs is rendered impossible by the fact that we can never know the phases of the reflections corresponding to the different spots. The ambiguity introduced in this way can only be removed by some physical artifice, such as the introduction of a heavy atom, or the observation of intensity changes on dehydration, which have not hitherto been carried out in practice. For all but one of the proteins examined, the task is made still more difficult by the presence of more than one Svedberg unit in the cell.

The resulting X-ray pattern in such cases depends both on the position of the molecules in the cell and on their internal structure. Fortunately the one exception, insulin, has only one molecule per cell. An X-ray study of dry insulin crystals has been made by D. Crowfoot[9] and the intensities of the reflecting planes determined. It is to be regretted that it was not possible to examine the crystals wet because in the dry crystals no planes of spacing less than 8 A. are observed, and consequently no evidence exists as to the fine structure of the molecule. The evidence on the coarse structure is, however, striking enough; it can most easily be seen from a study of the Patterson projections and Patterson-Harker sections which Miss Crowfoot has computed for insulin.

It should be explained that these projections do not represent the distribution of the density of scattering matter in the cell, but merely the product of the densities at points separated by a constant vector. It is not surprising, therefore, that the interpretation of these diagrams has already given rise to acute controversy. It seems natural to assume, though it is in fact an arbitrary simplification, that the peaks in the Patterson projection correspond to distances between a small number of high concentrations of scattering matter. Attempts have been made to reduce the analysis of the pattern to that of finding a pattern of points in space that will give maxima at the places observed. All these attempts have in fact failed. It is easy to find a large number of point patterns which will give the correct basal plane projection, but none of these will at the same time fit the sections. The claims to have done so[10] are based on the arbitrary selection of a certain number of vectors, and the agreement disappears if all the vectors are taken[11]. The failure to find a point solution suggests that we are dealing with groups of size of the same order as their distance apart, and that the appearance of the enhancement of reflections at spacings 10 A. and 4·5 A. corresponds to an arrangement of side-chains or backbone spacings similar to those occurring in the fibrous proteins.

On the basis of present X-ray knowledge, it is clearly impossible to arrive at any detailed picture of protein structure. Indeed, up to now the chief value of the X-ray method has been to disprove



HORSE METHHÆMOGLOBIN, *b* AXIS, OSCILLATION PHOTOGRAPH, THE RING COMING THROUGH CENTRAL SPOT SHOWING (*hko*) ZONE.

such hypothetical structures as have been put forward. It is, however, possible to formulate in a broad way some of the possible modes of arrangement and to suggest working hypotheses as a guide to future work.

The formal problems of structure of the protein molecule are:

(*a*) What is the nature of the link between amino-acid residues?

(*b*) Does the linkage run through the whole of the molecule or only through parts of it? In other words, is the protein one unit held together by primary valence forces, or is it made of sub-units held together in some different way?

(*c*) If such sub-units exist, what is the nature of the link between them?

As to the first question, the difficulty of accounting for the structure of spherical molecules out of a linear peptide chain has led to the idea of an alternate mode of linkage in which each amino-acid residue can be linked to four others and not

merely to two. While this hypothesis at first sight has a theoretical attractiveness, it still lacks any chemical support, and has been subjected to serious criticism on chemical grounds[12]. There are enough unknown factors in protein structure already without employing doubtful chemical assumptions.

The question of the unitary nature of the protein molecule arises whether the inter-residue linkage is peptide or not. With a multiple link it is easy to construct models either of the cage or solid type, but as has already been pointed out, it is difficult to reconcile such continuous structures with the definite 10 A. discontinuities revealed by the X-ray analysis. With a peptide chain, however, the unitary solution becomes more difficult. It is difficult to imagine any kind of fold or coil by which a single chain can occupy the observable space and at the same time not be so intricate that its formation by any natural process would be enormously improbable. There is, however, much evidence that at least the larger protein molecules are not unitary in structure. In the first place, some of them can be split in solution down to particles of molecular weight of the order of 10,000, and this is probably not the lower limit, as smaller particles are difficult to isolate or measure.

Two lines of X-ray evidence also point to sub-units, the high symmetry of protein crystals and the 10 A. repetitions. The symmetry of protein crystals is much higher than would be expected statistically from compounds of such great complexity. This would seem to indicate that each molecule is built of sub-units themselves unsymmetrical but arranged in a symmetrical way. The size of the sub-units must lie between that of the smallest protein observed, that is, one with a molecular weight 9,000, and that of a single amino-acid of molecular weight averaging 120, that is, it must contain some sub-multiple of probably 72 amino-acid residues. The uncertainty arises from the fact that it is not necessary for all the sub-units to be the same, though some must be to account for the symmetry. The presence of trigonal symmetry suggests that the asymmetrical unit must be a third or less of this number, that is, it must contain 24, 12, or 8 amino-acid residues.

The question of the structure of the sub-unit would seem to raise at first sight the same difficulties as the structure of the molecule itself. Actually, however, with the smaller number of residues the difficulties and the improbabilities of the coiling become much less, particularly if we postulate—which is not unreasonable—that the sub-units are closed peptide rings. Such rings would necessarily curl up owing to the mutual attraction of the positive and negative charged amino and keto groups in the chain, and models of such coiled chains can be constructed which preserve the distances between such groups that have been found in other compounds. The difficulty is, however, that there is a very large number of such possible models, and as yet nothing to choose between them. The method of folding in the chains in the sub-units may well be similar to that of the contracted form of the fibrous proteins mentioned above, and indeed a more detailed study of these may give us a clue to the whole arrangement.

The postulation of sub-units, however, raises further questions in the molecular structure, for they must be bound together sufficiently tightly to hold the molecule together in aqueous and ionic solutions. For this purpose a limited number of bonds are available. Ionic bonds are plainly out of the question, as they would certainly hydrate. There remains the possibility of amino-carboxy links between the ends of side-chains, but this is somewhat liable to the same criticism. It seems more probable that the links are either or both of two kinds, S-S linkages and association of hydrophobe groups. With the small number of sub-units, the number of S-S linkages needed to hold the molecule together is for all proteins hitherto examined sufficiently provided for by the amount of sulphur present, and the extreme changes in activity that proteins undergo when S-S bonds are broken indicate that they may have this fundamental part to play. Whether this is so or not, however, the behaviour of the hydrophobe groups of the protein must be such as to hold it together. As Danielli[13] and Langmuir[14] have pointed out, on the basis of surface-film work, the protein molecule in solution must have its hydrophobe groups out of contact with water, that is, in contact with each other, whereas on the surface the molecule is broken up into a film of 10 A. thickness in which the hydrophobe groups are driven out of contact with the water. In this way a force of association is provided which is not so much that of attraction between hydrophobe groups, which is always weak, but that of repulsion of the groups out of the water medium.

Langmuir has used this picture as a justification of the cyclol cage hypothesis, but it is strictly quite independent of it, and the model outlined above has the advantage of accounting very satisfactorily for the phenomenon of denaturation, particularly on a surface. Once the sub-units come to the surface, their rings are brought into a plane and different rings can interact according to the familiar ring-chain polymerization process, which will result in the formation of the fibres which Astbury has shown to exist in such films. This polymerization process takes measurable time as Danielli's work has shown.

The picture thus presented is far from being a finished or even a satisfactory one. The crucial fact that requires elucidation is the precise mode of folding or coiling of the peptide chains, and for this we may have to wait for some considerable time, until the technique of X-ray and other methods have been advanced much further than at present. The problem of the protein structure is now a definite and not unattainable goal, but for success it requires a degree of collaboration between research workers which has not yet been reached. Most of the work on proteins at present is uncoordinated; different workers examine different proteins by different techniques, whereas a concentrated and planned attack would probably save much effort which is now wasted, and lead to an immediate clarifying of the problem.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# Dr. William Thomson, F.R.S., a Forgotten English Mineralogist, 1761 - *c.*1806

By Dr. R. T. Gunther

WILLIAM THOMSON led two lives which seem never to have been correlated, certainly not in England. The first life culminated in his appointment as Dr. Lee's lecturer in anatomy at Oxford and his election into the Royal Society on March 16, 1786. The signatories to his certificate of candidature were the Hon. Charles Greville, Prof. R. Kirwan, John Hunter, S. F. Simmons, W. Pitcairn, Sir J. E. Smith, D. Pitcairn and Prof. T. Hornsby of Oxford. In 1790, he resigned all appointments, including the fellowship for which he had compounded on election. His second life was mostly spent in Naples during that pregnant period when Nelson and the British fleet featured so largely in all histories of Europe. There Thomson made a profounder study of volcanic phenomena than any Englishman, even counting Sir William Hamilton, had ever made before him.

That bibliographers have failed to connect the two lives is explained by Thomson's early death, and by his adoption of the name Guglielmo, and the signature "G. Thomson" for the few short articles that he published in Italian. Indeed he appears to have abandoned the use of his native tongue altogether. He was often addressed as "Dr. G. Thompson", and his only known address was "chez M. Heigelin" at the Danish Consulate in Naples.

My discovery of the identity of these two persons was due to the finding, in a contemporary collection of minerals, many fine specimens marked "Dr. T.", including a pat of Vesuvian lava moulded as a commemorative medal to Diodato Dolomieu, with the name "G. THOMSON ANGLUS 1805" impressed on the back. Prof. Lacroix confirmed this by finding in Paris a letter addressed by G. Thomson to Cuvier from Naples in 1801, in which he is described as "già Professore di Anatomia à Oxford". With these clues the rest was simple.

William Thomson's father was a well-known physician of the same name in practice in Worcester. In 1776, at fifteen years of age, the son came up to Queen's College, Oxford, but migrated to Christ Church in 1780 as a 'Canoneer' student. In 1781 he appears to have assisted Gough in connexion with the latter's work on a new edition of Camden's "Britannia"; and in October, "to complete his medical studies", he went to Edinburgh, but returned to Oxford to take his M.A. in 1783, B.Med. in 1785 and D.Med. in 1786. As Lee's reader he gave two courses a year in the Anatomy School.

Dr. Gibson, who has traced his career as physician to the Radcliffe Infirmary from June 12, 1786 onwards, has found that one morning in the spring of 1790 two murderers were hanged. In the same afternoon "their bodies were conveyed in a cart to the Anatomy School at Christ Church where Dr. Thomson next day gave a public lecture on the two bodies, to which the neighbouring faculty as well as those of the place were invited, together with the gentlemen of the University, and many of the principal inhabitants. The bodies were also publicly exhibited the day following". Some forgotten event must have occurred, for in the

following autumn he resigned all his appointments! Christ Church paid him £240 for the anatomical preparations he had made for the School, and Oxford knew him no more.

Thomson's new scientific life abroad probably began with a visit to Prof. Dolomieu in Paris. He spent the autumn and winter of 1791 in Tuscany, there making his first discovery of a new mineral, a beautiful pearl-like opal, on the old volcano of Santa Fiora; to which he gave the name of 'fiorite'. In Siena he made the acquaintance of Prof. Soldani, who in after years doubtless secured the publication of his last paper, on the Pallas meteorite, in the *Atti* of the Siena Academy. His engraving of its crystalline structure shows an anticipation of Widmanstätten figures of 1808. While spending the winter in Florence he received closely related specimens from other localities; and it was there that he found that by grinding certain quartz crystals with an emery wheel, he could demonstrate the existence of minute drops of naphtha enclosed in the crystals. Several mineral specimens in his collection were obtained from Tuscan localities. On reaching Naples he was certainly influenced by the great interest of the vicinity and began to observe and collect seriously. Scipio Breislack, the manager of the alum and sulphur works at the Solfatara, was doubtless one of his early friends and guide to the extinct volcanoes of the Phlegraean Fields.

On an excursion to Castellamare, Thomson noted the successive changes produced in the burning of limestone in a lime-kiln, and compared them with those in limestone blocks cast up by Vesuvius. In 1794 he visited the volcanic island of Ischia, where upon the Lacco rock he discovered siliceous deposits comparable to fiorite: and so, too, in the Solfatara.

On June 12, 1794, on the anniversary of Thomson's appointment at the Oxford Infirmary, Vesuvius broke out in violent eruption. A few days later molten lava, bursting the ash walls of the volcano, flowed down to the sea, overwhelming with fire and rock the greater part of the town of Torre del Greco on its way. It being impossible to approach the mountain by land, Thomson and Breislack witnessed the spectacle from a boat, in which, like the elder Pliny, they spent the night together but a few yards from the shore. Their observation that there was no great local disturbance of the water supported Breislack's belief that the sea had no direct access to the volcano.

By July 1795 the lava had cooled sufficiently for Thomson to visit the vent from which the lava had issued. The sand near by was covered with his siliceous stalactite. At a church at Torre del Greco against which the hot lava had come, he found crystals of pyroxene sublimed on the walls. From pits where quarreymen were uncovering their buried city, he made a special collection of objects that had been buried in the flowing lava, and mineralized by its heat and gaseous emanations. He was thus able to study in detail the chemical and physical changes in bronze, copper, silver, lead and iron in Nature's own laboratory, all described in detail by Breislack from specimens in the Thomson collection. His long series of altered marbles and limestones provided by Monte Somma has been specially praised. The new name, 'sarcolite', for a variety of analcime from Monte Somma was due to him. Other words of his coinage were 'glastein' and 'glastenised' for glass or obsidian that had undergone divitrification; 'mère-pierre' for the rock whence lava has come.

Thomson, trained both as a chemist and as a mineralogist, brought together the most scientifically collected series of minerals and rocks that had perhaps ever been made in a volcanic region. Its importance was repeatedly mentioned by Breislack and by Faujas de St. Fond: indeed the chapters in Breislack's book are entirely based upon Thomson's ideas and classification. Alexander von Humboldt and von Buch, who witnessed the eruption of 1804, visited him in 1805 and were enthusiastic in their praise of his collection: Gay-Lussac was also one of the party. By the time of Poulett Scrope's visit to Naples, he appears to have been forgotten.

Beyond a few contributions to the *Giornale Letteraria di Napoli* (not to be found in England), there is little else known of Thomson. He seems to have been an accomplished artist, for he drew his own illustrations: one was engraved for Breislack's book. In 1801 he was writing to Cuvier. About 1807 Faujas deplored his recent and premature death, and in the same year the whole, or a large part of his volcanic minerals reached Lady Hippisley, the wife of Sir John Hippisley, fellow of the Royal Society, and one of the first managers of the Royal Institution, at her country home at Ston Easton near Bath; and as labelled by her on arrival, it is largely in its original state. It has led to this first sketch for a biography: the date and place of his death still remain unknown.


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# Dundee Meeting of the British Association

THE meeting of the British Association in Dundee, which will run from August 30 until September 6, will be the third to be held in that city. The preliminary programme has just been issued. It is stated that for Dundee the present year is one of civic jubilee, for the town "attained the dignity of a city" in 1889: this coincidence with the meeting of the Association will not be overlooked. In referring to the previous meetings, mention is made of that in 1912 as "the occasion of a splendid act of generosity by a citizen of Dundee, the late Sir James Caird, whose gift of £11,000 to the funds of the Association enabled it to commemorate his name in the Caird Fund" for research.

The requirements of the Association in the way of accommodation for meetings and other functions will be more easily met this year than they were in 1912. The great hall which bears Caird's name has been built since that date: it will amply house the inaugural meeting on August 30, at which the president, Sir Albert Seward, will give his address on "The Western Isles through the Mists of Ages." The same hall will be the scene of a civic reception in the evening of August 31, of a graduation at which the University of St. Andrews will confer honorary degrees, on September 4, and of other items in the programme. The Reception Room and offices will be located in the Training College; the Victoria Art Galleries, which provided the Reception Room in 1912, will on the present occasion house a special exhibition of pictures, some from the city's permanent collection, others on loan from private collections in the district. The sections of the Association will be conveniently established, mostly in the University College, which immediately adjoins the Training College, and some in other buildings not far away.

The subjects of the presidential addresses in the sections, so far as they are announced, are as follows: Section A: Mr. R. S. Whipple on "Instruments in Science and Industry"; Section B: Prof. E. K. Rideal on "Film Reactions as a New Approach to Biology"; Section C: Prof. H. H. Read on "Metamorphism and Igneous Activity"; Section D: Prof. J. Ritchie on "Perspectives in Evolution"; Section G: Mr. H. E. Wimperis on "The Future of Flight"; Section H: Prof. W. E. Le Gros Clark on "The Scope and Limitations of Physical Anthropology"; Section I: Prof. D. Burns on "The Assessment of Physical Fitness"; Section J: Mr. R. J. Bartlett on "Measurement in Psychology"; Section K: Prof. D. Thoday on "The Interpretation of Plant Structure"; Section L: Dr. A. P. M. Fleming on "Education in Industry"; Section M: Sir Thomas Middleton on "Practice with Science. The Farmer's Position and the Scientific Worker's Programme".

Among other subjects announced for discussion in the sections are: In Section A, television, problems of high-speed flight, the surface temperature of stars and high-temperature problems. Sections A and B will join in a discussion on artificial radio elements. Section B will deal with light alloys and with intramolecular changes, and will join with Section I in discussing tissue respiration. Section C will deal, as usual at an opening meeting, with local geology, and in this connexion it may be mentioned that a sectional excursion will be held after the meeting during September 7–11, covering Edinburgh and a district from the coast to the north-east, to the hills to the south-west of that city. Section C will deal also with the raised beaches of Forth and Tay, and with the Old Red Sandstone - Carboniferous boundary. Section D will discuss the natural history of salmon and trout, and there will be an exhibition of biological films. Another subject to be dealt with by this section is problems of freshwater biology. Section E will discuss the national atlas which is at present under the consideration of a committee of the Section. Speakers from other sections concerned will take part in the discussion. Section F will deal with various Scottish economic problems. The programme of Section G includes problems of transatlantic aviation and air conditioning. Section H will return to the subject of the teaching of anthropology and will join with Section I in the discussion of nutrition and physique. In Section I this last topic will be associated with that of the assessment of physical fitness, and the Section will also deal with the problem of pain. This Section will hold a day's session at St. Andrews. Section L announces discussions on education as a preparation for industry, on educational research in Scotland, and on the Spens Report. Section M will review the subjects of grass conservation and seed potato growing.

Two special sessions under the auspices of the appropriate sections jointly, and a local committee, will deal with scientific aspects of the cultivation and treatment of jute and with problems associated with the jute industry.

The Conference of Delegates of Corresponding Societies will be presided over by Prof. H. L. Hawkins, who will give an address on "Local Scientific Societies and the Community".

The new Division for the Social and International Relations of Science, established last year at the Cambridge meeting, announces an afternoon session for papers and discussion on the co-ordination of scientific research, and on population, and it is understood that the possibility of a discussion on international co-operation in science is also under consideration. An evening meeting on Sunday, September 3, will hear an address from Sir Richard Gregory, chairman of the Division, on science and social ethics, and on Wednesday morning, September 6, a session of the Division will be devoted to a discussion on nutrition, which will form a complement to sectional discussions in this field already mentioned.

A new feature of British Association meetings will be the delivery by Dr. Isaiah Bowman, president of Johns Hopkins University, of the first of the lectures to be given under the arrangement concluded last year with the American Association for the Advancement of Science, by which, in alternate years, a speaker from America is to be invited by the British Association, and one from Great Britain by the American Association. Dr. Bowman has chosen as his subject "Science and Social Pioneering". A number of public lectures will be given not only in Dundee, but also in neighbouring towns. In this connexion it is of interest to recall that it was at the Dundee meeting in 1867 that the first lecture to the 'operative classes' was given, an annual series out of which the present public lectures developed: moreover, it was at the Dundee meeting in 1912 that for the first time, in response to public demand, more than one such lecture was given, a practice which has become common since that time.

The customary full list of excursions is announced —those on Saturday will include Blair Atholl, Dunfermline, St. Andrews, Braemar and other places, and there will be many visits to works and places and institutions of special interest to individual sections. Garden parties and a dance are announced, and the Dundee Horticultural Society will hold its flower show during the period of the meeting; the president of the Association will perform the opening ceremony.

The paragraph on accommodation for visitors begins with the frank statement that hotel accommodation in Dundee is rather limited, but a local committee is actively at work on the whole question of meeting visiting members' requirements, and there need be no fear of any difficulty if members will make known their wishes in accordance with the directions in the programme. The programme includes a list of all hotels and boarding-houses in Dundee and neighbouring places, and a list of lodging houses is in preparation. There will be a limited amount of accommodation in the hostels attached to University College, and the Medical School, and it should be specially observed that students' residence halls of the University of St. Andrews will be open to receive visitors; it is hoped that a service of special trains will be worked for the convenience of members staying in that town.

The announcements concerning publications include a reference to an important change decided upon at the Cambridge meeting. As from October 1939, the Reports of the Association will be published quarterly under the title of "The Advancement of Science" and the annual volume hitherto issued will be discontinued. So also will the collection of presidential addresses which have been issued at the time of the meeting under the title of "The Advancement of Science", which title will now be transferred to the new quarterly. It is stated, however, that individual addresses will be on sale separately during the meeting.

The preliminary programme is accompanied by an appeal from the general treasurer for an extension of membership of the Association. It is common knowledge that any person can, and very many do, take up membership only for the year of a particular meeting at which it is intended to be present: in particular, special efforts are always made to ensure that all interested residents in the locality of the annual meeting are given the opportunity to do this. But it is rather startling to learn from the present appeal that "of those who attend the annual meetings (apart from life members) only a small proportion—about one-quarter—are regular annual subscribers". The Association deserves a wider basis of permanent support than that, by a largely increased number whether of regular annual subscribers or of life members. It is pointed out in the appeal that "during the past few years the British Association has not hesitated to extend in fresh directions its activities for the advancement of science". Examples are given. In a reference to the new Division for the Social and International Relations of Science, established last year, it is stated that "the fields of activity already opened to view indicate that with more ample resources the Association will be able to undertake, through the Division, new work of national and international importance". Reference is made to the recent scientific delegation to India, an example likely to be followed elsewhere; to the arrangement for exchange of lecturers between the British and American Associations, made last year, and to various other opportunities which the Association

now possesses, within the framework of its constitution, to advance science, provided only that increased financial support is forthcoming. "These wide potentialities", the appeal states, "have all emerged in recent years; but there must always be borne in mind the field of scientific research and inquiry in which the Association has honourably laboured almost since its foundation. The ability to make grants for research is of the essence of its being, and to maintain and strengthen this activity is one of the first tasks of every successive General Treasurer."

The appeal deserves success, and it is to be hoped that it will achieve it. Its professed object, as has been said, is the extension of membership; but well-disposed persons will not overlook the possibility of strengthening the financial foundations of the Association by other means.

# Obituary Notices

## Prof. C. M. Jessop

CHARLES MINSHALL JESSOP, who died on March 9, was born on June 13, 1861. His father was vice-principal of Cheshunt Theological College, and it may be to this that he owed his strong religious views. Jessop was educated at King's College School, London, and Clare College, Cambridge. He was bracketed seventh wrangler in the mathematical tripos of 1885 along with James Harkness and Henry Stroud. Harkness was afterwards the joint author of Harkness and Morley's "Theory of Functions", and Stroud became, later, as professor of physics, Jessop's colleague in the Newcastle Division of the University of Durham. In the same year (1885) Jessop was elected a fellow of Clare.

After holding various teaching posts in schools, Jessop was in 1893 appointed lecturer in mathematics at the Durham College of Science, Newcastle-upon-Tyne, now King's College; in 1903 he was advanced to be professor of mathematics in the same College, a post which he held until his retirement in 1928.

Jessop's main mathematical interest was in geometry, and he frequently deplored the diversion of interest in Great Britain from geometry to other branches of mathematics. His contribution to the subject was his two books. The first, published in 1903, was a "Treatise on the Line Complex". Apart from J. H. Grace's account of the subject in the tenth edition of the "Encyclopædia Britannica", this was the first full treatment in English. It gave a complete discussion of the development of the subject at that time.

The second book was on "Quartic Surfaces with Singular Points", which appeared in 1912. This was welcomed as a valuable introduction to some of the latest results obtained by geometricians and at once took its place among the standard English treatises.

Jessop also published several smaller books, of which the most popular was the "Elementary Treatise on Trigonometry" which appeared in 1893, a joint work with E. W. Hobson.

Jessop had a fine appreciation of good mathematical style. He valued the subject for its own sake and was somewhat contemptuous of mathematics as a handmaid to the sciences. He was an inspiring teacher, especially to advanced students, and many hundreds owe their interest in mathematics to his able presentation.

## Dr. Alexander Hetherwick, C.B.E.

WE regret to record the death of the Rev. Alexander Hetherwick, for many years prominent as a missionary in Central Africa, which took place in Aberdeen on April 3 in his seventy-ninth year.

Alexander Hetherwick was born on April 12, 1860, and graduated from the University of Aberdeen with high honours in classics, mathematics, and theology, winning the Arnot Prize for experimental physics, and being Simpson mathematical prizeman.

At twenty-three years of age, Hetherwick volunteered for work with the mission of the Church of Scotland in Central Africa under Dr. Clement Scott at Blantyre. Five years later, in 1888, he succeeded Scott as head of the mission, a position he retained until his retirement in 1928. On his arrival in Central Africa the country, which afterwards became Nyasaland, was inhabited by pagan tribes dominated by the warlike Angoni, an intrusive immigrant offshoot of the Zulu stock; but his influence soon made itself felt. On his retirement he was Moderator of the Synod of Central Africa, in which the Presbyteries of Blantyre and Livingstonia, with those of the Dutch Mission, comprised some 40,000 members drawn from these pagan tribes.

It was not, however, for its Christianizing influence in the narrower sense that Hetherwick's work was remarkable. Under his guidance the Scottish Mission was conspicuous for its endeavour in instructing the native in handiwork and agriculture, and for its work among them in medicine and hygiene. Dr. Hetherwick himself was the foremost authority on the languages of the country. He translated the New Testament into the language of the Yao and was chairman of the board for the translation of the Bible into Nyanja. He wrote handbooks of the principal languages, and on his return to Scotland took up the revision of Scott's great dictionary of Nyanja. His knowledge of native customs and institutions was no less profound than his knowledge of their languages; and he was in those early days one of the principal sources of knowledge of the subject, on which he was a contributor to the *Journal* of the Royal Anthropological Institute. Dr. Hetherwick was twice a member of the Legislative Council, and received the thanks of the Colonial Office and the C.B.E. for his services to native welfare.

# News and Views

## International Relations

IN a speech on April 14 to the board of the Pan-American Union, President Roosevelt emphasized the fact that the people of the Americas can no longer consider the Atlantic as a barrier shutting them off from affairs in Europe. The rapidity and efficiency of modern communications make the world, East and West, a vast unity, no part of which can be disorganized without dire results for the whole. Mr. Roosevelt followed up this address with a message, which will surely go down in history as one of the most remarkable and far-reaching documents of our time, addressed to the heads of the German and Italian Governments. After referring to recent events in Europe, Africa and the Far East, and to the anxiety and tension plainly evident throughout the world, Mr. Roosevelt continued, "Nothing has persuaded the peoples of the earth that any governing Power has any right or need to inflict the consequences of war on its own or any other people save in the cause of self-evident home defence. . . . It is still clear to me that international problems can be solved at the council table. It is therefore no answer to the plea for peaceful discussion for one side to plead that unless they receive assurances beforehand that the verdict will be theirs, they will not lay aside their arms".

As a necessary preliminary to such discussions, Mr. Roosevelt asks for an assurance that no attack by the armed forces of Germany or Italy shall be made on any of thirty-one independent States, large and small, in Europe, northern Africa and the Near East for a period of ten or, better, twenty-five years. Such assurances, if given, would be transmitted to the Governments concerned, which in turn would be asked to give similar assurances to Germany and Italy. In the more peaceful atmosphere thus created, discussions should be immediately begun, in which the United States would take part, to enable the peoples of the world to "obtain progressive relief from the crushing burden of armament", and to open up international trade so that "every nation of the world may be enabled to buy and sell on equal terms in the world's market as well as to possess assurances of obtaining the materials and products of peaceful economic life". World problems are complex, and "study and discussion of these must be held in an atmosphere of peace. Such an atmosphere of peace cannot exist if negotiations are overshadowed by the threat of force or by the fear of war." Mr. Roosevelt's eloquent appeal for calm and dispassionate study of the intricate affairs of this troubled world needs no commendation from us; it is an appeal for the use of scientific method in the approach to the problems of international relations which all men of science would wish to see implemented now and for all time.

## Dr. Haakon Shetelig

THE award of the much prized gold medal of the Society of Antiquaries of London to Dr. Haakon Shetelig, keeper of the Bergen Museum and honorary fellow of the Society, is a fitting recognition of the work of Norway's most distinguished archæologist, whose researches on the Viking Age have contributed much to the understanding of an important phase in the racial and cultural history of Britain before the Norman conquest. Dr. Shetelig was born in 1877, became keeper of the Bergen Museum in 1901, and in 1914 was appointed professor of archæology. He was already well known to his English colleagues when his studies of the famous Viking ship of Oseberg were published. So long ago as 1906 he attended the York meeting of the British Association as a "distinguished foreign guest"; and he now has in the press a corpus, fully illustrated, of British Viking antiquities. Although Dr. Shetelig is best known for his work on the Viking period, it has by no means monopolized his studies. His work on Norway's prehistoric past is no less remarkable for its comprehensive breadth of view than for its lucidity of exposition. The presentation of the gold medal to Dr. Shetelig will be made at the anniversary meeting of the Society of Antiquaries to be held at Burlington House on April 27.

## Cave Culture of Palæolithic Age

A COLLECTION of objects of the smaller kind, mostly belonging to the class known to the French archæologist as *art mobilier*, which illustrates the culture of the cave-dwellers of the Upper Palæolithic Age, has been put on view for a short period in the prehistoric saloon of the British Museum (Bloomsbury). These objects, which are drawn from the collections in the Museum, are derived from the caves of the departments of the Dordogne and Tarn-et-Garonne of southern France. The phases of culture they specially illustrate are the Aurignacian and the Magdalenian. Among the specimens shown are the well-known design of two reindeer following one another on mammoth ivory, and a number of those heads of horses which are excellent examples of the skill of the palæolithic artist in seizing the salient features of animal life. This characteristic is especially to be noted in the eight specimens shown of the finely engraved animal figures on pebbles. The familiar but much prized and rare female statuettes in ivory of Aurignacian age, falling into the two classes of gross and slender, are not represented in the original, but by casts. An exhibit previously unrecorded is a tally rod of bone of the Aurignacian period. Examples are shown of the various types of harpoons, many of which are of extreme delicacy, and of the bone perforated needles, these being accompanied by the flint implements with which they were made. Among the exhibits of characteristic, or outstanding

examples of flint implements from the caves, is a remarkable example of delicate workmanship in the form of a leaf-shaped Solutrean point, measuring about nine inches long.

### Excavations on Pre-Roman Sites in Britain

DURING the past five years, land development at Ewell in Surrey has brought to light extensive evidence not only of Roman occupation, but also of a succession of pre-Roman settlements of considerable importance, some indeed dating so far back as the Mesolithic Age. A further find recently reported (*The Times*, April 14) lies west of the Epsom road, some two hundred yards west of the recently proved line of the Roman Stane Street. The discovery is due to Mr. A. W. G. Lowther. It includes relics of the Mesolithic Age, the Early Iron Age, dating at about 500 B.C. and of the Claudian and Hadrianic periods. The site is near that at Thayles Hill, on which Roman and Saxon remains were found a few years ago. The attraction to settlers here, it has been pointed out, was the dry belt of Thanet sand, which runs through Ewell, and the plentiful supply of water available from the famous springs. Mr. Lowther has dug out at about two feet depth a Roman road, in part well preserved, of the standard width of twenty-one feet. It is constructed of chalk blocks overlying the sand, and a surface layer of flints, in which was Hadrianic and later pottery. A much-worn coin of Domitian was found in an underlying well. Below the road were first century Roman pottery and a domestic oven, two pre-Roman ditches, pre-Roman iron slag and part of an iron ingot and much pottery dating back to 500 B.C., as well as a big light brown pottery water-container of the late Early Iron Age. Some twenty yards to the west of the road were the remains of a Romano-British hut, with Roman debris. A detailed account of the find is to be communicated to the Society of Antiquaries of London by Mr. Lowther in due course.

A SITE from which it may be anticipated that pre-Roman material of no little interest will be obtained is that at Silchester, on which stands, or rather stood, the Roman city of Calleva Atrebatum. Systematic excavations are to be carried out there under the direction of the Office of Works and the Archæological Institute. The Roman city was under excavation for a number of seasons around the beginning of this century by a Committee of the Society of Antiquaries of London under the direction of Mr. (afterwards Sir) W. H. St. John Hope, the assistant secretary of the Society. Much important material was then obtained from the site, which is now in the Reading Museum, and valuable detailed reports of the results of the excavation were issued. Attention was directed, however, exclusively to the remains of Roman date; but it is obvious that a position of geographical importance to attract the Romans must have invited prior settlement. In fact, it is believed that this is the site of a large early British settlement known as Caer Segont, and that this was surrounded by the mound and ditch, similar to that at Avebury, which encloses a much larger area than the Roman walls, presumably erected at a later date. Trial excavations in the area between the mound and the walls were carried out last year by Dr. Mollie Cotton and a party of volunteers; but operations are to be resumed on a more extensive scale this year, the excavators being drawn from Reading and other universities.

### The Science Museum: New Optical Instruments

THE Science Museum has recently received from Mr. Thomas H. Court a gift of a large number of early optical, mathematical and astronomical instruments, some of which are now displayed in a single group in the Optics Gallery. Mr. Court, who celebrated his seventieth birthday last year, has spent most of his life collecting early scientific instruments, and he is a foremost authority on the subject. For the last thirty years he has been presenting his best acquisitions to the nation, so that his gifts to the Science Museum now total more than nine hundred. The seventy objects which comprise Mr. Court's most recent benefaction include an Italian recipiangle of about 1600. This is an instrument used for measuring angles in surveying, and it is also marked with lines and scales which can be used for making calculations. There is an optometer invented by Thomas Young for testing eyesight and prescribing spectacles, there are early telescopes with vellum tubes, silver drawing instruments, a diagonal glass by means of which the visitor to the theatre or opera could observe his fellow spectators while appearing to be looking through his glass at the stage, and there are several fine astronomical reflecting telescopes by such noted eighteenth century opticians as James Short, John Bird and C. S. Passemant. Among the microscopes presented are several rare instruments of the seventeenth, eighteenth and early nineteenth centuries, notably a beautiful compound microscope of the Divini-Campani form with silver mounts, a number of very fine Culpeper-type microscopes and some of the earliest achromatic microscopes by English and Continental makers.

### Gas Fuel for the Internal Combustion Engine

THE internal combustion engine began with gas as fuel, but the use of concentrated liquid fuel has determined its vast development in all fields of transport. Circumstances, too familiar to mention, have in recent years caused a renewed attention to the possibilities of reverting, in part at least, to the use of gaseous fuel from coal and even coal itself. In Continental countries this has been encouraged by fiscal and other forms of State aid. On March 27–28, the Institution of Mechanical Engineers held a conference at Swansea, when the position of the subject was reviewed. It was reported that in 1938 a producer-fed passenger bus had maintained for one year a regular service from Inverness covering 32,000 miles. Its fuel cost was £90—as against £253 for petrol and £136 for oil. There was a charge for cleaning and attention of £30. In all producer-fed vehicles one must reckon on a 30 per cent loss of power owing

to extra weight and cost due to the producer. On the Continent there are many gas-engined small vessels fed by producer gas. The position attained by engines fed by compressed gas was reviewed and it was considered that engines using injected fuel with high compression ratios will give performances equal to those of compression ignition engines operated with fuel oil. Progress with road vehicles has been determined by the use of thin walled containers of alloy steel capable of working at 3,500 lb. pressure. Dr. H. Wahl gave an optimistic account of the position and future of an engine running on coal dust.

### National Smoke Abatement Society

FOR many years the National Smoke Abatement Society, from headquarters in Manchester, pursued its modest efforts to secure a purer air and for the last ten years it has issued a quarterly journal. Since its removal to London, its efforts have been accompanied by greater progress. Even Whitehall has almost gone over to smokeless fuel and the L.C.C. has become more active. The extensive rebuilding in progress all over Great Britain is providing an unusual opportunity to diminish atmospheric pollution. Even the coal industry, long indifferent to the manner in which its wares were consumed, is showing an increased desire to avoid the reproach of causing smoke. The Society has taken a further step by issuing its journal in a new form, larger, more ambitious and under the more attractive name of *Smokeless Air*. This will be issued quarterly at 1*s.* and for 2*s.* 6*d.* post free per annum. The first number of the new series is bright and well produced, containing news of the movement and interesting articles on the subject of atmospheric pollution. At its price it ought to receive a much wider circulation.

### Telephone and Telegraph Statistics of the World

IN *Electrical Communications* of October 1938, statistics of the telephone and telegraph services of the world are given. The telephone development of the world by countries is first discussed, the figures taken being for January 1937. North America possesses nearly 54 per cent of the total number of telephones in the world, the United States alone possessing nearly 50 per cent, and having 14·4 per cent per 100 of the population. South America possesses 2 per cent of the total and nearly 1 per cent per 100 of the population. The whole of Europe possesses 36·5 per cent of the total world number and has an average of 2·4 per 100 of the population. Great Britain and Northern Ireland, France, Germany, Italy and Russia have 7·5, 4·0, 9·25, 1·5 and 2·6 per cent of the total world telephones and 5·9, 3·5, 5·1, 1·3 and 0·6 per 100 of the population. Asia possesses nearly 4·6 per cent of the world's total, of which about three quarters belong to Japan. Africa possesses about 0·9 per cent of the world's total, of which more than half belong to the Union of South Africa. Oceania possesses nearly 2·3 per cent, Australia having 1·5 per cent. The number of telephones per 100 of the population is also given for large cities. Washington and San Francisco head the list each with 37. Stockholm comes next with 35. Then New York with 22, London with 16, Paris with 15, Berlin with 13, Rome with 8, Tokyo with 3·9, Moscow with 3·5 and Shanghai with 3·4. In Canada, Montreal with more than a million inhabitants has 16 telephones per 100 of the population, and Toronto with more than three quarters of a million inhabitants has more than 25 telephones per hundred. In 1936, the total number of 'wire' communications, that is, of telephone conversations and telegrams per capita in Canada was 222, of which only 1 was a telegram. In the United States it was 211, 1 being a telegram, and in Great Britain and Northern Ireland it was 44, the number of telegrams sent per capita being a little greater than 1.

### Meteorology in India

THE report on the Administration of the Meteorological Department of the Government of India in 1937–38 shows that certain undertakings that had been under consideration for a number of years were carried out. Of these the most important is considered to be the daily preparation of an afternoon synoptic weather chart at the Meteorological Office at Poona, which was begun on April 1, 1937. This has enabled that office to issue forecasts twice a day instead of only once. This afternoon synoptic chart is printed in the Indian Daily Weather Report, and adds greatly to the value of that report. Another important development was introduced on August 1, 1937, when the short-wave aeronautical wireless stations at Karachi and Calcutta began to issue regional broadcasts of synoptic data twice daily. The new Burma Meteorological Department followed this lead by beginning the broadcasting of data for stations in Burma from October 1, 1937. With the commencement by the Posts and Telegraphs Department of the construction of a short-wave wireless station at Poona, the time is approaching for the issue from headquarters of collective and regional synoptic issues. Further plans were made in accordance with recommendations made at a meteorological conference held in Delhi in December 1936. They included the reopening of a forecasting office at Delhi and the transfer of the Upper Air Office from Agra to Delhi. These plans were approved in principle by the Government of India, but sanction for putting them into effect had to be postponed owing to the unfavourable financial situation. Another new development was the introduction at the request of the Royal Indian Navy of an arrangement for broadcasting synoptic data and weather bulletins for the whole of the Indian waters from the Navy Wireless Station at Bombay, for the benefit of shipping. The new broadcasts are additional to those issued from the civil wireless stations at Bombay and Calcutta.

### *Osiris*

VOL. 4, part 2 of *Osiris*, edited by Dr. G. Sarton, published in 1938, is a monograph on "Science, Technology and Society in Seventeenth Century England", by Robert K. Merton, and its content is

defined by the author as "an empirical examination of the genesis and development of some of the cultural values which underly the large-scale pursuit of science". The "Dictionary of National Biography" has been selected as the source of information of an occupational census and the data subjected to a tabulation process. On the basis of this information a further survey of discoveries based on Darmstaedter's "Handbuch zur Geschichte der Naturwissenschaften und Technik" was compiled. This indicated the particular interests which arose in different times in the period studied. The influence of religious movements such as Puritanism is considered. The influence of external factors is carefully examined. The whole study is very interesting and suggestive in many fields but suffers from the lack of a detailed table of contents, so that the intention of the work is not easy to grasp, and the author's conclusions are not easy to find in the mass of detail. Vol. 5 of *Osiris*, which now rejoices in a Latin title as *Commentationes de scientiarum et eruditionis historia rationeque volumen quintum et Iulio Ruska oblatum*, is dated 1938, and is edited by Dr. Sarton assisted by Dr. Pogo. It contains some interesting and valuable papers on scientific incunabula (to which a recent volume of *Osiris* was devoted), on Arabic algebra (incidentally, the history of mathematics has occupied a prominent place in the journal so far), on Kopp, the historian of chemistry, on astronomy, on Michael Scot (a subject which has now been about worked to death), on animals in the Bible, and on other subjects. There is a biographical and bibliographical notice of Ruska and a portrait. These two volumes of *Osiris* maintain the high standard of scholarship of the publication, and are indispensable to students of the history of science.

### Royal Cornwall Polytechnic Society

In its several ways the Royal Cornwall Polytechnic Society continues to stimulate interest in the traditions and archæology of the county as well as in science. Lectures are given, prizes for essays awarded, excursions are made and much is done for meteorology by the maintenance of the Falmouth Observatory and the support of the Cornwall Rainfall Association. All these matters are referred to in the one hundred and fifth annual report, recently issued, which is accompanied by some of the original contributions to the Society. The Society was founded when the Cornish metalliferous mines were in full swing, and in a paper entitled "The Ancient Mining Districts of Cornwall" Mr. F. J. Stephens gives a review of the score or more of mines which existed within two miles of the coastline, in the parishes of Illogan, St. Agnes and Perranzabuloe. Another contribution, but in lighter vein, is an account of the opening of the railway to Falmouth in 1863, from which it was hoped the district would gain much by the re-opening of the port of Falmouth as a terminus for steamship lines, while in yet another Mr. E. Chirgwin treats of the dialect of Cornwall. As in other parts of Great Britain, the dialect "is speeding from the presence of compulsory instruction, the cinema, the motor coach, the daily paper and the thousands of visitors" who flock to the district. As usual, Mr. W. T. Hooper gives a series of valuable meteorological notes, in which he shows that those discontented because perpetual sunshine is not to be enjoyed at Falmouth, have little about which to complain.

### Japan Institute for Science of Labour

The annual report of the director of the Japan Institute for Science of Labour for 1937 gives a brief account of the history of the Institute as well as of its divisions and functions (Tokyo: Japan Institute for Science of Labour, 1938. 70 sen). A programme of proposed investigations, including studies on nutrition and the prevention of industrial accidents and occupational disease, is also outlined which indicates how sadly warped the whole outlook of Japan has become under the demands of her policy of war and aggression. Brief notes are included on investigations completed in 1936–37, among which may be mentioned a study of dust in mail-cars and a survey of the labour conditions of railway postal workers. The first part of an investigation on gaseous metabolism in heavy muscular work has been completed, covering gaseous exchange in static effort, and a third report on occupational diseases of printers, especially lead poisoning, deals with the density of dust in the air and the window space in the printing shop. A statistical analysis has been made of the causes of death in different occupations, and other studies have included acute nicotine poisoning among land workers and water supply in an agricultural village.

### The Lily Year-book

The Royal Horticultural Society's Lily Year-book for 1938 (London: the Society's Office, Vincent Square, S.W.1. Pp. 181+35 plates. 5*s*. paper; 6*s*. cloth. 1938) contains an account by Messrs. A. B. Stout and W. M. Porterfield of "Seed Patterns and Incompatibilities in *Lilium candidum*". It is shown that incompatibilities may occur among sister plants of the same species. Such disabilities are physiological in nature, and are not to be confused with failures in hybridizing fertilizations. An ingenious method of estimating incompatibility by the examination of seeds has been used. The results are considered in relation to the practical promotion of fertility by late fertilization, when suitable stigmatic secretion is developed, and by artificial treatments of the stigma. The Year-book contains numerous papers about the horticultural treatment of lilies; Dr. Fred Stoker has a useful article upon the geographical origin and classification of the Carniolicum group of lilies; Mr. A. D. Cotton contributes a short biography of Père Armand David (1826–1900), the celebrated naturalist and explorer; and Mr. E. O. Clement describes various practices for the germination of lily seed in Ontario. The year's work upon lilies revealed by the volume indicates a lack of contributions of a fundamentally scientific nature. Reports of discussions at meetings of the Society's Lily Group, published in the present Year-book (pp. 42–79), and similar accounts in earlier

years, show that those whose interest in lilies is practical and aesthetic, need, and desire, the specialized help of the geneticist, the physiologist and the pathologist.

### *Scientia Genetica*

WITH the object of stimulating the development of genetics in the Latin countries, a new journal, *Scientia Genetica*, is being launched under the direction of Prof. Carlo Jucci of the University of Pavia and with his colleague Prof. Adriano Buzzati-Traverso as its editor-in-chief. Though it is primarily intended to provide an appropriate medium for publication for geneticists in these particular countries, original papers from elsewhere will be welcomed so long as they are written in Italian, French, Spanish or Portuguese, and possess a strictly genetical interest. There is to be a special section for abstracts, reviews of recent books and for summaries of original papers dealing with animal and plant breeding (such papers will not be published in full). At the end of each year there will be given a complete bibliography of papers of genetical interest that have appeared in the scientific literature of the Latin countries, and from time to time there will be presented a critical review of some selected field. Geneticists will welcome this addition to the literature of their science. It undoubtedly supplies a need, and it may be expected to play a notable part in the inevitable advancement of genetics not only in the Latin countries but also in the world as a whole.

### Beneficial Insects

IN 1922 the Ministry of Agriculture and Fisheries issued a small publication on "Beneficial Insects". It contained little-known information, written in a non-technical style, on those insects that are beneficial to the farmer, fruit-grower and gardener. During the sixteen years which have elapsed, this bulletin has passed through three editions and has been reprinted on five occasions. Knowledge of insects of this kind has greatly increased in the interval and the practical measures that can be taken to increase their usefulness have been extensively investigated. This new bulletin (No. 20; 1939) has been entirely re-written by Dr. W. R. Thompson and forms a useful non-technical introduction to the subject. It is obtainable from His Majesty's Stationery Office, or through any bookseller, price 9*d*. net.

### Advanced Study at the University of Cambridge

THE University of Cambridge has recently published abstracts of ninety-one dissertations approved during the academic year 1937–38 for the Ph.D. (75), M.Sc. (11) and M.Litt (5) degrees. The abstracts are full enough (averaging about a page and a half) to give a fair idea of the substance of the dissertations. They may be roughly grouped as follows: the humanities 26, pure science 55, applied science 10. The actual distribution according to faculties is: divinity 2, moral science 2, classics 3, English 4, modern and medieval languages 6, history 3, economics and politics 3, archæology and anthropology 2, geography 1, mineralogy and petrology 4, mathematics 8, physics 6, chemistry 14, botany and zoology 15, biochemistry and physiology 8, agriculture 3, engineering 7.

### North Pacific Earthquake

AN earthquake of moderate intensity occurred on November 17, 1938, and its epicentre has been determined by the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association as lat. 55° N., long. 158° W. It is estimated to have normal focal depth. This preliminary determination was made with the help of readings from the following stations: Georgetown, Fordham, Weston, Chicago, Ann Arbor, Ukiah, Victoria, San Juan, St. Louis, Tucson, Philadelphia, Williamstown, Butte, Bozeman, Honolulu, Manila, Sitka, Pasadena, College, Burlington, Huancayo and Kew. The epicentre is situated under the ocean bed to the south of the Alaska Peninsula, and is not far distant from the scene of the violent earthquake of November 10, which was lat. 56° N., long. 150° W.

### National Physical Laboratory: Publications

THE demand for the first issue of the "National Physical Laboratory Abstracts", which covered papers contributed by the Laboratory to the scientific and technical press during the year 1936, has proved its value to industry and has justified the recent issue of a similar pamphlet for the year 1937. The abstracts of papers in the present issue cover sixty-seven pages and on the average an abstract occupies a little less than half a page. They are arranged in order of subject: engineering, metallurgy, electricity and heat and general physics abstracts occupying 7–11 pages each and other subjects less. Both author and subject indexes are provided. The pamphlet may be purchased directly from H.M. Stationery Office, price 1*s*.

### Finney-Howell Research Fellowships

FINNEY-HOWELL RESEARCH FELLOWSHIPS have been renewed for the following: Dr. P. C. Aebersold, University of California, Berkeley; Margaret E. Boyland, Royal Cancer Hospital, London; Dr. Alma Howard, McGill University, Montreal; Dr. Ll. M. Joshel, Harvard University; Dr. Ll. W. Law, Jackson Laboratory for Cancer Research, Bar Harbor, Maine; Dr. H. Lisco, Johns Hopkins Hospital, Baltimore; Dr. C. S. McEuen, McGill University; Dr. W. C. Merkel, Union Memorial Hospital, Baltimore. Fellowships for 1939 have been awarded to the following: G. M. Badger, of Melbourne, Australia, to work at the Royal Cancer Hospital, London; Dr. A. Kirschbaum, to work at Yale University; Dr. J. L. Melnick, to work at Yale University; Dr. J. F. Menke, to work at Stanford University Hospital; Dr. J. L. Wood, to work at Harvard University; Dr. P. C. Zamecnik, to work under Dr. K. Linderström-Lang at the Carlsberg Laboratory, Copenhagen. Grants in aid have been awarded to Dr. R. D. Fowler and Dr. R. W.

Graham, jun., Johns Hopkins University, and Dr. G. O. Gey, Johns Hopkins Medical School. Applications for 1940 awards must reach the office of the Foundation (Medical and Chirurgical Faculty Building, 1211 Cathedral Street, Baltimore) by January 1, 1940.

### A Large Sunspot

A LARGE sunspot of rapid development crossed the central meridian on April 16·1. When photographed at the Royal Observatory, Greenwich, on April 13, at 10 h. U.T., the spot had an area of 150 millionths of the sun's visible hemisphere; twenty-four hours later the spot, which had become of complex structure, had increased to 1,000 millionths. This is the largest spot seen during the past four months. Greenwich also reports a considerable magnetic disturbance recorded at Abinger as having begun suddenly on April 17 at $1^h\ 55^m$. There would appear to be a definite association between the big sunspot and the terrestrial magnetic storm.

### Announcements

M. JACQUES DUCLAUX, professor of general biology in the Collège de France, Paris, has been elected a free academician of the Paris Academy of Sciences, in succession to the late M. d'Ocagne.

DR. ALBERT SZENT-GYÖRGI, professor of medical chemistry at Szeged, Hungary, has been awarded the A. W. Hoffmann Memorial Medal by the German Chemical Society.

DR. T. MORAN, principal scientific officer at the Low Temperature Research Station, Cambridge, has been appointed director of research at the Laboratories at St. Albans of the Research Association of British Flour-Millers, in succession to Dr. E. A. Fisher. Dr. Moran will take up his duties on June 1.

COLONEL A. S. ANGWIN, deputy engineer-in-chief, has been appointed Engineer-in-Chief of the Post Office, on the retirement of Sir George Lee on May 31.

ON March 29, the Earl of Athlone, as president of the National Hospital for Nervous Diseases, Queen Square, formally accepted the Associated British Cinemas Laboratory for Biochemical Research and the Gaumont-British Laboratory for Histological Research.

A COURSE for those engaged in the training of mental defectives in occupation centres, institutions or mental hospitals and for home teachers has been arranged by the Central Association for Mental Welfare. Further information may be obtained from the Educational Secretary of the Association, 24 Buckingham Palace Road, London, S.W.1.

THE annual meeting of the U.S. National Academy of Sciences is to be held in Washington during April 24–25. The sessions for the presentation of scientific papers are open to the public. In the evening of April 24, the president of the Royal Society, Sir William Bragg, will deliver the second Pilgrim Trust Lecture, which will be entitled "History in the Archives of the Royal Society".

THE Meyer Medal for distinguished services in plant introduction has been awarded by the American Genetic Association to Miss Kate O. Sessions, of San Diego, California. Miss Sessions, who is eighty-two years of age, has contributed greatly to the horticultural beauty of southern California through fifty years of active work spent there as a landscape gardener and horticulturist. The Meyer Medal is awarded periodically by the Council of the American Genetic Association.

A NATIONAL conference on the "Wider Aspects of Nutrition" will be held under the auspices of the British Medical Association in the B.M.A. House, Tavistock Square, London, W.C.1, during April 27–29. The inaugural address will be delivered by Sir Arthur Salter. The following sessions will be held: (1) Medical Aspects of Nutrition; (2) Means of Stimulating Production, (*a*) Home Agriculture, (*b*) Overseas Producers; (3) Means of Stimulating Consumption, (*a*) Family Allowances, Provision of Cheap or Free Milk or Meals in Necessitous Cases, (*b*) Education. On April 28, at 8.15, Prof. V. H. Mottram will deliver the Sir Charles Hastings Public Lecture entitled "Nutrition and the Public Health". Admission to the conference is by ticket obtainable from the secretary of the B.M.A.

THE following appointments and promotions in various branches of the Colonial Service have recently been made: T. F. Blood, inspector of produce, Nigeria; F. A. Leeds, inspector of plants and produce, Gold Coast; I. Sibson, inspector of plants and produce, Gold Coast; R. Johns (agricultural officer, Zanzibar), agricultural officer, Fiji; A. F. Nichols (assistant director of agriculture), director of agriculture, Seychelles; W. M. Robertson (conservator of forests, Sierra Leone), conservator of forests, Tanganyika Territory; F. B. Higgins (senior inspector of mines), chief inspector of mines, Gold Coast; R. L. Creery (veterinary officer), senior veterinary officer, Kenya; W. G. Emerson (veterinary officer), senior veterinary officer, Kenya; W. Fotheringham (veterinary research officer), senior veterinary research officer, Kenya.

WE have received from Messrs. Griffin and Tatlock, Ltd., Kemble Street, London, W.C.2, a copy of their new 1,150-page Catalogue No. 15 B of modern chemical apparatus. This has been entirely rewritten in the light of modern laboratory equipment and technique, and comprises a very wide range of apparatus for use in all branches of chemistry. It is planned in thirteen sections, in each of which the items are in alphabetical order, and there is a detailed general index. The apparatus is illustrated and in many cases there are adequate descriptive notes, so that the volume is much more than a mere catalogue of prices. In many cases the theory of the apparatus is briefly yet adequately described. This catalogue would be found of great value in any chemical laboratory.

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 686.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## A New Type of 'X-Ray Microscope'

A STANDARD method of X-ray analysis consists in measuring the strength of the diffracted beams corresponding to a series of reflections around a crystal zone (for example, the reflections with indices $h0l$ around the $b$ axis), and then forming a double Fourier series with the amplitudes $F$ as coefficients.

$$\Sigma\Sigma\, F(h0l) \cos\left\{\frac{2\pi hx}{a} + \frac{2\pi lz}{c} + \alpha(h0l)\right\}$$

The sum of this series gives the density of scattering matter at a point $x,z$ when the contents of the unit cell are projected on the face (010). In the case of a centro-symmetrical projection $\alpha(h0l)$ is either 0 or $\pi$, and if there are sufficiently heavy atoms at the centre of symmetry, it is zero for all reflections. The present note describes a simple and rather striking optical method of effecting the summation for a case where $\alpha(h0l)$ is always zero.

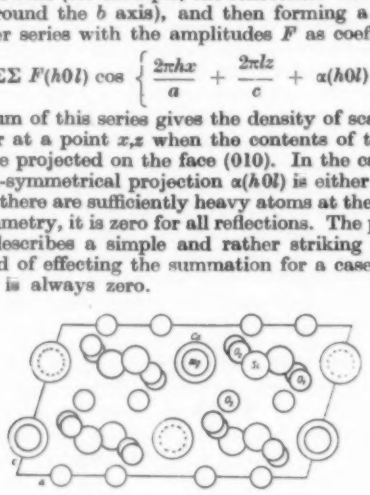


FIG. 1.

Holes are drilled in a thin plate of brass, one for each reflection $h0l$. The area of the hole is proportional to $F(h0l)$ and the holes are arranged in the positions of cross-grating spectra. The plate represents, in fact, a section through the reciprocal lattice containing all $h0l$ reflections. The plate is placed between a pair of good lenses, of about 6-ft. focal length. A point source of monochromatic light (a pin-hole in front of a mercury vapour lamp) is placed at the focus of one lens, and the image of the pin-hole at the focus of the other lens is viewed through a microscope. The diffraction of the light by the holes in the plate results in a very realistic image of the crystal structure being seen through the microscope. Each pair of holes $F(h0l)$ and $F(\bar{h}0\bar{l})$ forms a set of parallel diffraction fringes, and these sets have the right amplitude, spacing and phase to build up the double Fourier series given above.

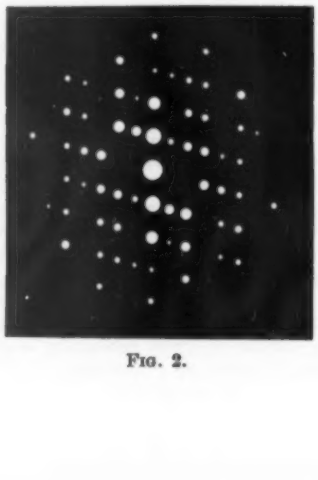


FIG. 2.

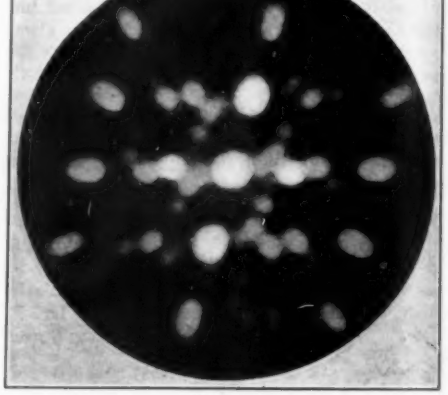


FIG. 3.

Fig. 1 shows the projection of diopside, $CaMg(SiO_3)_2$[1], on the plane (010). The largest circles represent superimposed Ca and Mg atoms at symmetry centres of the projection, these atoms being so heavy that $\alpha(h0l)$ is zero for all reflections. The intermediate circles are silicon, the smallest are oxygen. Fig. 2 is twice natural size and is from a contact print of a brass plate drilled with holes to correspond to the $h0l$ spectra given by the crystal (see[2] Fig. 3*b*). Fig. 3 is a photograph of the diffraction image seen in the microscope when this plate is placed between the lenses as described above, and it will be seen that it is a faithful reproduction of the crystal structure shown in Fig. 1.

We are now searching for a device for dealing with the more general case of values of 0 or $\pi$ for $\alpha(h0l)$, for example, a ready way of placing a film with a half-wave retardation over certain holes. If this can be found, the method may prove to be of practical use in crystal analysis.

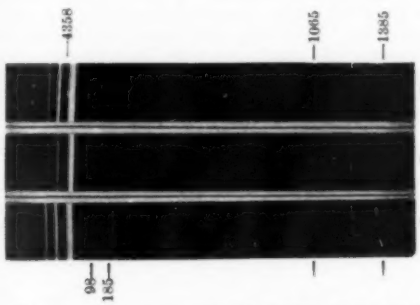
Cavendish Laboratory, Cambridge. W. L. BRAGG.

[1] *Z. Krist.*, **60**, 168 (1928).
[2] *Z. Krist.*, **70**, 475 (1929).

## Lattice Oscillations in Crystals

THE ions or molecules occupying the cells of a crystal lattice are in general optically anisotropic, and should also be capable of executing small angular oscillations about their positions of equilibrium. If the crystal is illuminated by monochromatic light of frequency $\nu$, the local fluctuations in optical polarization produced by such oscillations should result in scattered radiations appearing with altered frequency, and theory indicates that these should exhibit *peculiar polarization characters*.

Taking an individual ion or molecule to be optically an ellipsoid, its polarizability along three mutually perpendicular directions being $A$, $B$, $C$ respectively, it is clear that if the light-vector $E$ in the incident beam is parallel to an axis $A$ of the ellipsoid and its angular oscillations are also about the same axis, there would be no fluctuations in optical polarization and therefore no radiations of altered frequency. If, however, the ion or molecule oscillates about a second axis $B$ with an angular amplitude $\theta$ and frequency $\nu^*$ the optical polarization would fluctuate with frequencies $\nu \pm \nu^*$; the corresponding scattered radiations would arise from a Hertzian dipole which is parallel to the third axis $C$ of the ellipsoid and has the strength $\frac{1}{2}(C-A)\theta E$, where $\theta = (h/2\pi^2 I\nu^*)$, $I$ is the moment of inertia and $h$ is Planck's constant. The scattered radiations would thus be of maximum intensity in the plane containing the oscillation axis and the incident light-vector and would vanish in the direction perpendicular to this plane. In other words, the displaced lines in the spectrum due to these oscillations in the lattice would disappear in just the direction in which the displaced lines arising from the symmetric internal vibrations of the ion or molecule would be of maximum intensity.




EFFECT OF ORIENTATION OF CRYSTAL ON LIGHT SCATTERING IN SODIUM NITRATE.

(*a*), (*b*), and (*c*) illustrate the foregoing remarks; they are spectra of the 4358 A. radiation of the mercury arc, transversely scattered by a sodium nitrate crystal, the incident light being plane polarized. The three spectra correspond to three mutually perpendicular settings of the crystal; the directions of the incident light-vector and of observation of the scattered light are normal to each other and remain unaltered throughout. It will be noticed that in (*a*), in which the optic axis of the crystal is parallel to the direction of observation, the lattice lines (98 cm.$^{-1}$ and 185 cm.$^{-1}$) have disappeared, while in (*b*) and (*c*) they appear strongly. On the other hand, the internal oscillations (1065 cm.$^{-1}$ and 1385 cm.$^{-1}$) of the $NO_3$ ion appear strongly in (*a*) and (*b*), while in (*c*) they are very weak. The latter result is to be expected, as (*c*) corresponds to the case in which the incident light-vector is along the optic axis of the crystal, and the polarizability of the $NO_3$ ions is a minimum in this direction.

C. V. RAMAN.
T. M. K. NEDUNGADI.

Hebbal, Bangalore.
March 10.

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## Transmutation of Thorium by Neutrons

IN a previous letter we have proposed schemes for the disintegration of radioactive noble gases, formed by the bombardment of uranium with slow neutrons[1]. We repeated these experiments, passing the active gases over absorbent carbon instead of through water, which resulted in appreciably higher activities. We were able to confirm our earlier measurements and found 33 minutes as a more accurate value for the longer cæsium-period (instead of 30 minutes). It may be remarked that there is a satisfactory agreement between our results and those obtained by Hahn and Strassmann[2].

We have now studied the formation of radioactive noble gases by the splitting of thorium nuclei with neutrons in an analogous way. As this process requires fast neutrons, we used the following experimental arrangement. The neutrons were produced by the (Li + D) reaction. The neutron source was immersed in a concentrated solution of thorium nitrate. Thus, although the water slows down the neutrons, an appreciable part of those present in the liquid still have high energies. A fast stream of nitrogen was passed through the solution and, after being dried with phosphorus pentoxide, entered a $U$-shaped tube filled with active carbon and immersed in liquid nitrogen. The radio elements were extracted from the carbon with water containing cæsium, rubidium, barium, strontium and lanthanum ions. This solution always contains thorium B and C originating from thoron absorbed by the active carbon. This fact made it necessary to carry out a lead precipitation before isolating the barium, and to purify as a perchlorate the cæsium contained in the precipitate with antimony trichloride. The irradiations ranged from 5 minutes to 60 minutes.

Except for the 2-minute alkali period, our results were identical with those obtained in the investigation of uranium. We determined the same periods for rubidium (17 min.), barium (87 min.) and cæsium (10 min. and 33 min.). Strontium was found to be inactive. It may be concluded that the splitting of uranium nuclei and of thorium nuclei leads to the same noble gases, and that the schemes suggested for uranium in our first communication hold for thorium too. As the time required for the preparation of the precipitates was longer in the case of thorium than it was in our investigation of uranium, it was impossible to search for the 2-min. alkali period.

A. H. W. ATEN, JUN.
C. J. BAKKER.
F. A. HEYN.

Natuurkundig Laboratorium,
N. V. Philips' Gloeilampenfabrieken,
Eindhoven.
April 5.

[1] Heyn, Aten, jun., and Bakker, NATURE, 143, 519 (1939).
[2] Hahn and Strassmann, *Naturwiss.*, 27, 163 (1939).

## Number of Neutrons Liberated in the Nuclear Fission of Uranium

RECENT experiments have shown that neutrons are liberated in the nuclear fission of uranium induced by slow neutron bombardment: secondary neutrons have been observed which show spatial[1], energetic[2] or temporal[3] properties different from those which primary neutrons possess or may acquire. Such observations give no information on the mean number of neutrons produced per nucleus split; this number $\nu$ may be very small (less than 1) and the result of the experiment will still be positive.

We are now able to give information on the value of $\nu$. Let us consider the curve representing the density distribution of neutrons slowed down in an aqueous solution surrounding a primary neutron source[2]; the area $S$ of this curve is proportional to $Q.\tau$, $Q$ being the number of neutrons per second emitted by the source or formed in the solution, and $\tau$ the mean time a neutron spends in the solution before being captured. Assuming that the solution contains only nuclei which absorb neutrons according to the $1/v$ law (the only exception to this rule will presently be dealt with), $\tau$ is proportional to $1/\Sigma c_i\sigma_i$, where $c_i$ is the concentration (atom grams per litre) of an absorbing nucleus, $\sigma_i$ its cross-section for the capture of neutrons of velocity 1 and the index $i$ is extended to all kinds of neutron-absorbing reactions attributable to nuclei present in the solution. Substituting the symbol $A_i$ for $c_i\sigma_i$ and $A_{tot}$ for $\Sigma A_i$, we have identically:

$$\frac{\triangle S}{S} = \frac{\triangle Q}{Q} - \frac{\triangle A_{tot}}{A_{tot}}, \qquad (1)$$

neglecting all terms of higher orders, such as those containing $(\triangle Q)^2$, $\triangle Q.\triangle A_{tot}$, etc.

Let the symbol $\triangle$ stand for the differences observed between the two solutions (uranyl and ammonium) used in our previous experiment[1]. Neglecting $\triangle A_{tot}$ before $A_{tot}$ introduces an ambiguity in the definition of $A_{tot}$ (uranyl *vs.* ammonium value) which is numerically unimportant and can be reduced by adopting the arithmetical mean $(A_{tot}(\text{amm.}) + \triangle A_{tot})/2$.

In the quantity $\triangle A_{tot}$ the uranium nuclei are represented by several separate terms standing for the different modes of neutron capture (see below); let $A_f$ be the term for the capture leading to fission. Every neutron has the probability $A_f/A_{tot}$ of causing a fission and, since one individual fission process liberates $\nu$ neutrons on the average, the total number $\triangle Q$ of neutrons thus created is $Q.\frac{A_f}{A_{tot}}.\nu$, and the equation (1) can be rewritten as follows:

$$\nu = \frac{\triangle S}{S} \cdot \frac{A_{tot}}{A_f} + \frac{\triangle A_{tot}}{A_f}. \qquad (2)$$

Let us estimate the values of all quantities necessary to calculate $\nu$ according to this formula. The area variation $\triangle S/S$ can be read from the graph given in our previous letter with an error of less than 20 per cent (due to the uncertainties of inter- and extrapolation; in order to facilitate the latter, we added to the curves a further experimental point for $r = 29$ cm.). The value of $A_{tot}$ for the ammonium solution can be easily calculated from the known concentrations and capture cross-sections (hydrogen, nitrogen and oxygen). $A_f$ is equal to $c_U$ (1·6 in our experiment), multiplied by the value of $\sigma_f$ given in a recent paper by Anderson *et al.*[4]. $\triangle A_{tot}$ contains a term expressing the small difference of the hydrogen content between the two solutions; and three terms relative to uranium, namely, the fission term $A_f$, already dealt with, the thermal capture term $A_{ct}$ which can be calculated by using a recently found value for $\sigma_{ct}$ [5] and finally the resonance capture term $A_r$ which requires some explanation.

Our reasoning assumed that all neutrons introduced into the solution spend practically all their life, and are absorbed, in the thermal state. This is true in so far as the $1/v$ law is valid for absorption of neutrons in all nuclei concerned; and, therefore, not wholly true for uranium, which shows a pronounced resonance capture of neutrons of about 25 volts[6]. A certain proportion of neutrons entering the solution is bound to come within this resonance band and to be absorbed by resonance; therefore, it will never reach the thermal state. This proportion depends on the width of the resonance band and on the concentration $c_U$; its value in our system of symbols is equal to $A_r/A_{tot}$ and was numerically determined by an experiment reported elsewhere[5].

Putting all numerical values in the formula (2) (with $10^{-24}$ cm.$^2$ as the unit of cross-section), that is: $\triangle S/S = 0{\cdot}05 \pm 0{\cdot}01$; $A_{tot} = 36 \pm 3$; $A_f = 1{\cdot}6 \times 2 = 3{\cdot}2$; $\triangle A_{tot} = 8{\cdot}7 \pm 1{\cdot}4$ decomposable into $\triangle A_H = 1{\cdot}2 \pm 0{\cdot}1$, $A_{ct} = 1{\cdot}6 \times (1{\cdot}3 \pm 0{\cdot}45) = 2{\cdot}1 \pm 0{\cdot}7$, $A_r = 6{\cdot}4 \pm 1{\cdot}1$ and $A_f = 3{\cdot}2$, we find:

$$\nu = 3{\cdot}5 \pm 0{\cdot}7.$$

We were not able to allow for an error in $A_f$, since the value of $\sigma_f$ given by Anderson *et al.* contains no indication of probable error. Any error in $\sigma_f$ will affect $\nu - 1$ in an inversely proportional way; in any case $\nu$ will remain greater than 1.

The interest of the phenomenon discussed here as a means of producing a chain of nuclear reactions was already mentioned in our previous letter. Some further conclusions can now be drawn from the results reported here. Let us imagine a medium containing only uranium and nuclei the total neutron absorption of which, as compared to that of uranium, may be neglected (containing, for example, only some hydrogen for slowing down purposes). In such a medium, if $\frac{A_f}{A_{tot}} . \nu > 1$ ($A_{tot}$ includes now only uranium terms), the fission chain will perpetuate itself and break up only after reaching the walls limiting the medium. Our experimental results show that this condition will most probably be satisfied (the quantity $\frac{A_f}{A_{tot}} . \nu - 1$, though positive, will be, however, small), especially if one keeps in view that the term $A_r$, because of the self-reversal of the resonance absorption line, increases much more slowly than the other uranium terms when the uranium content of the medium is increased.

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## Radiobromine

Don C. De Vault and W. F. Libby[1] and E. Segrè, R. S. Halford and G. T. Seaborg[2] have shown that the 4·5-hr. radiobromine transforms into the 18-min. isotope which is β-active, by the emission of soft γ-rays. Le Roux, Lu and Sugden[3] find that this is the method of disintegration of at least 90 per cent of 4·5-hr. radiobromine. Segrè, Halford and Seaborg[2] predicted that the γ-rays would be soft, and a large proportion would be internally converted.

These considerations are in agreement with observations made in a Wilson chamber of the disintegration of 4·5-hr. radiobromine. Measurement of tracks starting from thin foils which had been activated with radiobromine, and from active ethyl bromide introduced as a vapour into the chamber, show homogeneous energy groups of electrons due to the $K$ and $L$ conversion of this γ-ray, superimposed on a background of the continuous β-ray spectrum of the β-active isotope.

In those experiments in which tracks start in the gas of the chamber, half the electrons produced by the internal conversion of the γ-rays in the $K$ level are accompanied by short tracks starting from the same atom and due to the Auger conversion of the $K$ X-rays of bromine. The existence of these X-rays was reported by Philip Abelson at the December meeting of the American Physical Society at Los Angeles. The Auger electrons accompanying $L$ conversion would not be observed.

These experiments show that the γ-rays have an energy of 43,000 electron volts. The coefficient of internal conversion in the $K$ shell is of the order of 0·30, and that in the $L$ shell much smaller.

Since Le Roux, Lu and Sugden effected a 90 per cent separation of the isotopes, the loosening of the bond discussed by Segrè, Halford and Seaborg must be due to this low-energy γ-ray alone.

In even so brief a summary as this, I would like to make twofold acknowledgments. For advice and discussion on the physical side I must thank Prof. P. M. S. Blackett, Prof. J. D. Bernal and Dr. L. Simons; I wish also to thank Prof. S. Sugden for help and advice, especially on chemical matters.

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## Formation of Helium of Mass 3 in an Excited State

AN excited state of helium of mass 3 ($^3$He) has been previously suggested by me to explain a second low-energy group of neutrons from the deuteron-deuterium reaction[1]. Since present theory does not predict such an excited state[2] in $^3$He, it is important to establish definitely whether such a state actually exists. This note gives the results of some cloud chamber experiments which were made in order to investigate this point.

In the present experiments, the D-D reaction was studied with a cloud chamber filled with either methane or helium. The neutrons were detected by means of the recoil protons or recoil helium nuclei. The ranges of those recoil particles were measured which were projected in the forward direction (0–10°). Three series of experiments were made. In the first experiment methane was used in the cloud chamber and the neutrons were observed at 90° to the direction of the 0·9 Mv. deutrons. In the second experiment the conditions were the same except that helium was used in the cloud chamber. In the third experiment the neutrons were observed at an angle of 0° to the 0·5 Mv. deuterons. A summary of the results is given in the accompanying table.

| Type of recoils | Deuteron energy (Mv.) | Angle of observation | Neutron energies (Mv.) | Relative intensity of recoil groups | | Relative intensity of neutron groups | |
|---|---|---|---|---|---|---|---|
| | | | | low energy | high energy | low energy | high energy |
| H | 0·90 | 90° ± 8° | 1·5 ; 2·8 | 0·28 | 1·00 | 0·17 | 1·00 |
| He | 0·90 | 90° ± 15° | 1·5 ; 3·0 | 0·92 | 1·00 | 0·1–0·2 | 1·00 |
| H | 0·50 | 0° ± 9° | 1·93 ; 3·55 | 0·19 | 1·00 | 0·12 | 1·00 |

In each of the experiments a second low-energy group of neutrons was observed as well as the high-energy group. A significant feature is the increase in the energy of the low-energy neutron group when the bombarding voltage was reduced to 0·5 Mv. and the neutrons were observed in the same direction as the deuterons (0° ± 9°). In this case, although the maximum energy of the neutrons produced in the target is reduced from 4·07 Mv. to 3·55 Mv., the low-energy group of neutrons has more energy. This definitely shows that they are not produced by scattered neutrons. Furthermore, the increase in energy is just what one should expect from the reaction

$$^2\mathrm{H} + {}^2\mathrm{H} \rightarrow {}^3\mathrm{He} + {}^1n.$$

The $Q$ values of the reaction were calculated from the data obtained at 0·5 Mv. The disintegration values are $Q^0 = 3{\cdot}32 \pm 0{\cdot}04$ Mv. and $Q^1 = 1{\cdot}48 \pm 0{\cdot}04$ Mv. These agree within the experimental error with those I obtained previously with quite a different experimental arrangement. The relative intensities of the two neutron groups as given in the table were computed by means of the known relations between collision cross-section and energy, for neutrons[3].

These experiments show that the $^3$He nucleus is left in an excited state at 1·84 Mv. in approximately 15 per cent of the disintegrations. At the present time it is not clear what happens to the excited $^3$He. Experiments on the gamma rays from this reaction seem to give too small an intensity[4]. However, the transition to the ground-state may be strongly forbidden as in the case of the 1·426 Mv. gamma ray of radium C′, and so there may be a high internal conversion of the gamma rays. Another possibility is that the excited $^3$He emits a positive electron with an energy of about 0·8 Mv.

A more complete description of these experiments will be published elsewhere.

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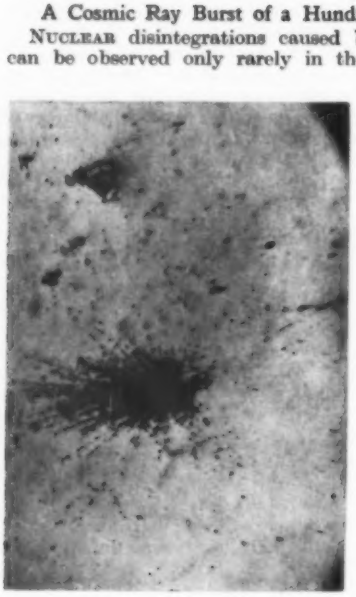
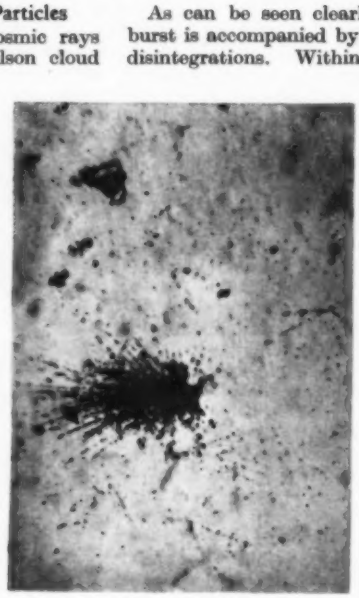
## A Cosmic Ray Burst of a Hundred Particles

NUCLEAR disintegrations caused by cosmic rays can be observed only rarely in the Wilson cloud chamber. We have developed in recent years[1] a more effective method of observing these nuclear disintegrations. In this method photographic plates coated with thick emulsions (thickness~50 μ) are exposed to the action of cosmic rays and then developed.

I have recently[2] made experiments at sea-level and at an altitude of 9,000 metres with such plates placed horizontally with their emulsions downwards, and I have found that the number of disintegrations and heavy particles per disintegration increases rapidly with increasing altitude. One case, which is reproduced herewith, is a burst of a hundred heavy particles. The two pictures are stereoscopic micro-photographs taken with a magnification of 190. More tracks can be seen by stereoscopic examination of the original plate than on the reproduction. It can also be seen that all the particles diverge from one centre which is within the emulsion. The centre is quite large and contains many unresolved tracks. The black centre may be caused not only by heavy particles but also by the electron stream accompanying the burst. (Separate electron tracks cannot be seen as the emulsion is insensitive to them.)

In this burst there are twelve tracks of length equivalent to 18 cm. normal air situated within a cone of 30°. Assuming that these are proton tracks, the total energy calculated from the range is 40 Mev. In addition to these there are thirty tracks each with a range of 12 cm. (in normal air) within a cone of 70°. The appearance of the tracks at their ends suggests that they may be due to α-particles. If the tracks are due to protons their total energy is approximately 50 Mev. There are also between fifty and sixty particles lying in a cone of wide angle with ranges of approximately 5 cm. Assuming that these particles are protons, their total energy must be 80–90 Mev. Thus the total energy of the whole burst must be at least 200 Mev.





As can be seen clearly in the reproduction, the burst is accompanied by a number of separate small disintegrations. Within the field of vision, which was of 0·4 mm. in radius, four disintegrations with three tracks, one disintegration with four particles, three disintegrations each with five particles and two showers of heavy particles were found. There were thus ten disintegrations of total energy 50 Mev. within an area of 0·4 mm.², a disintegration density which is seventy times greater than is ordinarily found on these plates.

It should be noted that there are also many disintegrations outside of the field of vision of the microscope.

A more detailed account will appear in the *C.R. Acad. USSR.*

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## Optical Properties of Dental Enamel

IT has been known for many years that dental enamel is birefringent; and its optical properties have been studied intensively by W. J. Schmidt and his pupils[1]. In a recent paper[2], I have shown by X-ray examination that an enamel prism contains a multitude of regularly arranged crystallites of apatite, and have worked out in detail the orientation of these crystallites for human deciduous enamel. It was therefore felt to be of interest to determine whether the optical and X-ray results could be correlated.

The main feature of the structure suggested by X-rays is the presence in a single enamel prism of two groups of submicroscopic crystallites of hydroxy-apatite, the hexagonal axes of one group being inclined to the prism direction at about 5°, and those of the other group at about 40°. The intensity of the light transmitted by such an arrangement of crystallites, when the enamel is examined between crossed nicols, has been worked out; and it has been found that the calculated extinction phenomena, for both longitudinal and transverse sections of prisms, correspond closely with those actually observed by Schmidt, Keil and other workers.

The problem is essentially that of calculating the interference effects due to the superposition of two

differently oriented uniaxial crystal plates; a problem first attacked by Fresnel[3] and discussed more recently by Schulz[4]. The formulæ derived for the intensity of the transmitted beam may be applied directly to the case of a tooth section of known thickness, if the prisms are assumed to be parallel to each other, by making the thicknesses of the two crystal plates proportional to the numbers of crystallites belonging to the 5° and 40° groups referred to above.

The work forms part of an investigation being carried out for the Dental Disease Committee of the Medical Research Council, and will be published in full elsewhere.

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## Non-Euclidean Geometry in Microscopic Space

CONSIDERATIONS of Heitler, Nordheim and Teller[1], based on Heisenberg's uncertainty principle, show that Newtonian gravitation has only a macroscopic significance; further, in the theory of ultimate particles, it is necessary to introduce a finite length, $a$, of approximately $10^{-13}$ cm. (radius of electron or of light nuclei), which is not justified theoretically if we use Euclidean geometry or Einstein's gravitational curvature.

Consequently, it seems more convenient to use a non-Euclidean geometry, but one which is not connected with Einstein's gravitational theory; in the space occupied by the elementary particle, the square of the space-time interval is supposed to be defined by:

$$ds^2 = c^2\left(1-\frac{r^2}{a^2}\right)dt^2 - \frac{dr^2}{1-r^2/a^2} - r^2(d\theta^2+\sin^2\theta\, d\varphi^2) = c^2\gamma dt^2 - d\sigma^2 \qquad (1)$$

which is formally analogous with de Sitter's line element; the internal space is consequently spherical with a curvature $K = 1/a^2$, and the corpuscle is obviously stable, because the Einstein macroscopic relation $R = \varkappa\rho$ between the world-curvature $R$, the density of matter $\rho$ and the gravitational constant $\varkappa$ (which involves expanding space) is not verified.

Let the line element of the external space be defined by:

$$ds^2 = c^2\left(1-\frac{a^2}{r^2}\right)dt^2 - \frac{dr^2}{1-a^2/r^2} - r^2(d\theta^2+\sin^2\theta d\varphi^2); \qquad (2)$$

therefore, there will be a nuclear attractive field, different from the Einstein or Newtonian field, which can be neglected if $a$ tends to zero.

The spatial part of (1) represents a spherical or elliptic space[2] in which distance is not univocally defined; in the second case, a line element results from the Cayley relation:

$$\sigma = \frac{a}{2i}\log\chi, \quad (i=\sqrt{-1}) \qquad (3)$$

where $\sigma$ is the distance between two points $A,B$, $\chi$ the anharmonic ratio $\overline{AK}/\overline{BK} : \overline{AL}/\overline{BL}$, $K$ and $L$ the points of intersection of $\overline{AB}$ with the absolute quadric[3]. The relation (3) is analogous to Schrödinger formula $S = \frac{h}{2\pi i}\log\psi$ between action function $S$ and wave function $\psi$; therefore, it is possible to quantize distance; $\chi$ is univocal and $\sigma = \sigma_0 + m\pi a$, where $m$ is an integer; the quantum numbers are $\pm\frac{1}{2}$.

Metric notions are completely replaced by projective notions when we introduce for an angle $V$, Laguerre's formula:

$$V = \frac{1}{2i}\log\varphi \quad (i=\sqrt{-1}); \qquad (4)$$

angular quantum numbers are spin quantum numbers $\pm\frac{1}{2}$; we specify that $\chi$ and $\varphi$ have an immediate experimental significance, as $\psi$ in quantum mechanics, while angles and distances lose their actual meaning.

Therefore, metric transformations $T$, which preserve $V$, are replaced by corresponding homographic transformations $H$ which preserve the anharmonic ratio $\varphi = \frac{\lambda_3-\lambda_1}{\lambda_3-\lambda_2}\cdot\frac{\lambda-\lambda_2}{\lambda-\lambda_1}$; the projective parameter $\lambda$ is changed by $H$ in

$$\lambda' = \frac{\alpha\lambda+\beta}{\gamma\lambda+\delta}; \qquad (5)$$

it is easy to prove that, in the usual cases, this transformation is identical with the unitary substitution of two variables of Van der Waerden[4].

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[1] From Gamow, *Phys. Z.*, **38**, 800–814 (1937).
[2] Tolman, "Relativity, Thermodynamics and Cosmology" (Oxford, 1934), p. 346.
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## Temporary Poikilothermy in Birds

IT appears to be well known to aviculturists and collectors that humming-birds are capable of a physiological state somewhat resembling hibernation in mammals, but of short duration; however, the fact seems not to have been recorded in the scientific literature. We propose to refer to this peculiar condition as 'torpidity'. The observations here recorded were made partly in the field in Ecuador, partly in the Zoological Society's Gardens at Regent's Park.

In complete torpidity, the birds are quite rigid, with head drawn back and pointed up, flattened plumage and closed eyes, and exhibit no perceptible respiratory movements. The condition is reversible, recovery in captivity taking 10–15 minutes, at high altitudes and low temperatures in Ecuador up to 30–35 minutes.

Partial torpidity is also observed. In captive birds this is characterized by violent breathing, ruffled plumage and the loss of the power of flight. Recovery from this state takes 4–5 minutes. Partially or completely torpid birds on being touched emit a peculiar expiratory whistle, which, it is suggested, may be due to deflation of the air-sacs.

Torpidity is promoted by numerous factors: (1) low temperature; (2) lack of food; (3) poor condition; (4) a diurnal effect, birds being much more susceptible at night; (5) a seasonal rhythm, captive birds having proved much more susceptible in

November–December than at the same night temperatures in August or March; (6) a size effect, large species in captivity being in general less susceptible than small; (7) a climatic effect, lower temperatures being required to induce torpidity in species from high altitudes, but the resultant torpidity then being more extreme, with longer recovery period; (8) a specific effect, susceptibility varying in species of similar size and habitat; (9) an individual effect, individuals of the same species showing different susceptibility (this may in part be due to temporary differences in condition).

Torpidity appears to be a temporary poikilothermy, rather similar to that already described for bats[1]. In birds, one of us (C. S. W.) has noted a similar but less specialized condition in colies (*Colius*). Torpidity of a rather different nature has also been noted in swallows[2], but here recovery is only possible before complete torpidity is reached.

Torpidity in the fully specialized condition seen in humming-birds appears to be an adaptation promoting the survival of these very small birds in conditions which temporarily make the maintenance of normal body-temperature difficult or impossible. The fact, however, that it occurs also in a related family (colies), and scarcely, if at all, elsewhere among birds, indicates a general preadaptive proneness to the condition.

Temperature measurements of birds in different stages of torpidity will be undertaken with a thermocouple next winter, and will be incorporated with a fuller account of avian torpidity in general.

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[1] Burbank, R. C., and Young, J. Z., *J. Physiol.*, **82**, 459 (1934).
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## Segregation in Asexual (Apomictic) Offspring in *Rubus*

THE diploid species of *Rubus* we have examined always reproduce sexually. In the polyploid forms and species, however, reproduction may be (1) entirely sexual, (2) entirely non-sexual, apomictic, or (3) partly sexual and partly non-sexual.

The polyploids vary widely in the degree to which apomixis is developed, and a particular species used as female parent will show a variation in behaviour according to the species used as male in the pollination. The occurrence of segregation is not conclusive evidence of sexual reproduction, for we find that segregation occurs within the non-sexual offspring and has given rise to new and distinctive types, which in some cases breed true. For example, *R. nitidioides*, $2n = 28$, a species with comparatively small flowers and normal five-leaflet leaves, when crossed with *R. thyrsiger*, $2n = 28$, gave plants of three kinds, (1) a very small proportion of sexual hybrids, (2) a large proportion identical with the maternal parent *R. nitidioides*, and (3) a new true-breeding form with large flowers and seven-leaflet leaves, which shows no trace of the male parent. The dicecious species *R. vitifolius*, $2n = 56$, with three-lobed leaves, when crossed with the diploid *R. idaeus*, $2n = 14$, gives offspring all of sexual origin, and all are pentaploid, $2n = 35$. *R. vitifolius* crossed with the tetraploid form of *R. idaeus*, $2n = 28$, however, gave a family consisting of plants of two kinds, with 42 and 56 chromosomes. The 42 chromosome plants are of sexual origin and have many of the characters of the male parent, such as hermaphrodite flowers and five-leaflet leaves. The 56 chromosome plants, on the other hand, show no trace of *R. idaeus*, and are evidently of apomictic origin. They all have three-lobed leaves and are identical with *R. vitifolius*; but approximately one half of the plants have female flowers and the other half male flowers. The progeny as a whole is dicecious like the female parental species. We therefore have segregation of characters even with an apomictic mode of reproduction. Evidently the apomictic embryo arises at a stage subsequent to the first division of meiosis, presumably by diploid parthenogenesis. This means that there are intermediate methods of reproduction which although superficially vegetative have certain of the properties of sexual reproduction, giving rise to genetical variation through crossing-over.

Incidentally, the results we have obtained with the American species *R. vitifolius* show that the conclusion of Gustafsson[1] that "all American species belonging to the *Rubus* subgenus Eubatus are sexual" is not of universal application.

The results are also significant in view of the difficult taxonomy of *Rubus*. They show not only how new forms and species can arise, but also how they are able to maintain themselves in Nature. Many of the species and micro-species of *Rubus* are evidently clones and sub-clones, produced by segregation and maintained by apomixis.

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## A Difference in Response of Normal and Tumour Tissue

PREVIOUS papers have reported the effect of respiratory stimulating factors (*RSF*) prepared from yeast on the respiration of liver, skin and yeast[1,2,3,4]. The object of the research here reported was to investigate the effect of a crude sample of *RSF* on transplantable tumour tissue.

In the present experiments, crude *RSF* was prepared from Fleischmann's bakers' yeast (*Saccharomyces cerevisiæ*) by a method reported by Cook, Kreke and Nutini[4]. The preparation used in these experiments corresponds to sample *A* in the above work. The crude *RSF* was prepared by extracting yeast successively with 95 per cent and 50 per cent alcohol, combining the extracts and concentrating *in vacuo*. The concentrated extract was redissolved in distilled water and autoclaved at 15 lb. pressure for 15 minutes. The *p*H was adjusted to 7·3.

Preliminary experiments showed that this crude extract in a concentration of 13·9 mgm./c.c. stimulated the respiration of mouse liver 160 per cent and of mouse skin 50 per cent.

Employing Warburg direct manometric technique, the effect of the *RSF* was tested on the respiration of transplants of a spindle-cell carcinoma of the mammary gland. The transplantable tumour (15091*a*) was obtained from the Roscoe B. Jackson

Memorial Laboratory and transplants were made in mice 7–8 months old. The age of the transplants used ranged from 14 to 17 days.

There was no stimulation of respiration of the tumour tissue noted when this *RSF* was added in a concentration of 13·9 mgm./c.c. to the Ringer-glucose-phosphate (0·02 per cent glucose) solution in which the tumour tissue was suspended. The average $Q_{O_2}$ for a series of fourteen determinations was 5·2 (limits, 4·1–6·8) with *RSF* and 5·3 (limits, 4·0–7·4) without *RSF*. Certain other cell-free tissue extracts which stimulate the respiration of normal tissues have failed to stimulate tumour respiration. For example, a cell-free extract prepared from tumour increased the oxygen uptake of liver but not of tumour. Spleen extract was the only one used in our laboratory which stimulated the respiration of tumorous tissue, which confirms the earlier observation of Büngeler[5].

This difference in response of normal and tumour tissue to the *RSF* preparation under investigation might be interpreted as indicating a qualitative difference between normal and tumour metabolism. At present there is insufficient evidence to show whether this is true; indeed, the bulk of previous evidence has led to the belief, in Boyland's words[6], that "in the mechanism of tumour respiration there is no known qualitative difference between normal and tumour tissue". This work does affirm that there is damage to the oxidative mechanism in malignant tissue as has been found by Dickens[7] from measurements of the respiratory quotient.

The crude *RSF* has been fractionated by different methods, and experiments are now being conducted to test the effect of these fractions on normal and tumour tissue. It is not impossible that prolonged application of *RSF* to tumour tissue, either *in vitro* in tissue culture or by injection, will have a favourable effect. These possibilities, together with the use of further autogenous preparations, are being studied. The effects of *RSF* on other phases of normal and tumour metabolism are under investigation.

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March 6.

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## Nutritive Spheres in *Amœba proteus* Y

THE impetus given to the investigation of cytoplasmic inclusions by the ultra- and electric-centrifuge technique used in the recent work of Brontë Gatenby and his pupils has raised once more the controversy concerning the exact nature of the nutritive spheres in *Amœba proteus* Y.

Dr. Singh[1] confirms the findings of Sister Carmela Hayes[2] that the nutritive spheres contain glycogen. I would direct attention to one significant remark at the end of Sister Carmela's paper which indicates the possible explanation of discrepancies in descriptions of the reactions of living organisms to various reagents, namely, her conclusion that the exact chemical composition of the nutritive sphere depends upon its physiological condition at the time of the experiment.

Dr. Singh does not wholly agree with those who maintain that I confused nutritive spheres with agametes. I hope to publish elsewhere my renewed investigations on the life-history of *A. proteus* Y. My purpose in writing this note is to direct attention to a method of demonstrating the presence of glycogen and of making very instructive permanent preparations of *A. proteus* Y, which may be useful for busy teachers.

The amœbæ after being allowed to 'expand' are fixed in Bouin's fluid, washed in alcohol, stained in a 1 per cent solution of chlorazol black[3] in alcohol, dehydrated in 'Cellosolve'[4], cleared in xylol and mounted in Canada balsam.

The glycogen can easily be detected around the nutritive spheres by its red colour[5]. The interior of the sphere stains a pale green.

Since 90 per cent alcohol can be used as a fixative for *A. proteus* Y, the amœbæ can be fixed and stained simultaneously by treatment with a 90 per cent alcoholic solution of chlorazol black, thus limiting the remaining operations to dehydration in 'Cellosolve' and making permanent 'in Euparal'.

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## Sea Island Cotton and the Lamarckian Theory

PROF. MACBRIDE[1] cites Sea Island cotton as an example of a strain evolved in response to a particular environment (in this case the sea islands of South Carolina) which only retains its distinctive characteristics under those particular conditions. He has, unfortunately, been misinformed. The perennial ancestors of Sea Island cotton were introduced from the West Indies into Carolina in the latter half of the eighteenth century and there selected for the annual habit. The annual types were sent to the West Indies about thirty-five years ago and have retained unchanged the annual habit and very high quality characteristic of the Carolina type. A Barbados stock has been cultivated on a small scale in Fiji for fifteen years and has maintained not only the general Sea Island characteristics, but also the distinctive superfine quality of the Barbados strain. In the U.S.S.R. and in Sind also American stocks have been grown for a number of years without reversion.

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## A Chemical Method of Assay of Insulin

IN a recent communication[1], Vogelenzang suggests the possibility of an iodometric method for estimating the physiological potency of insulin preparations. A similar suggestion was previously made by Brand and Sandberg[2]. Jensen, Schock and Sollers[3], however, pointed out that the success of an iodometric titration of insulin is dependent upon the amount of impurities which will react with iodine. Since iodine reacts upon certain chemical groupings which are by no means confined solely to the insulin molecule, it is doubtful whether the physiological potency of insulin preparations can be reliably determined by iodometric titration. Blatherwick and associates[4] have arrived at the same conclusion.

The protein nature of insulin[5] makes it improbable that a simple chemical method of assay will ever become practicable.

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## Points from Foregoing Letters

W. L. BRAGG describes a direct method of converting the measurements of X-ray beams diffracted by a crystal into an optical image of the atomic arrangement as projected upon a given plane. Holes are drilled in a thin plate, arranged in the pattern of 'cross-spectra', and proportional in area to the amplitudes of the diffracted beams. If this plate is placed in front of the objective of a telescope focused on a point source of monochromatic light, the beam passing through the holes forms by interference an image of the crystal structure which can be seen through the eyepiece.

Photographs of spectra of light scattered by a crystal of sodium nitrate set successively in three mutually perpendicular directions to the incident monochromatic polarized light are submitted by Sir C. V. Raman and T. M. K. Nedungadi. They show that when the optic axis of the crystal is parallel to the direction of observation, the 'lattice lines' have disappeared; other lines which may be ascribed to the internal oscillations of the $NO_3$ ion appear strongly in this position and also in one of the positions perpendicular to it, but are very weak in the third position when the incident light-vector is along the optic axis.

It is stated by A. H. W. Aten, jun., C. J. Bakker and F. A. Heyn that radioactive noble gases arise from the bombardment of thorium with neutrons. At least one radioactive krypton and two radioactive xenons are formed, which are identical with those obtained from uranium irradiated with neutrons.

Discussing experimental results on the liberation of neutrons in the nuclear fission of uranium, H. von Halban, jun., F. Joliot and L. Kowarski estimate that an average of about 3·5 neutrons is liberated in every fission. They discuss the conditions of establishing a self-perpetuating reaction chain which seems to be theoretically possible.

R. E. Siday has observed in a Wilson chamber the $K$ conversion electrons of γ-rays emitted when 4·5-hr. radiobromine transforms into the 18-min. isotope. The γ-rays appear to have 43,000 electron volts energy with a coefficient of internal conversion of roughly 0·3. The Auger electrons produced by the $K$ X-rays accompanying the $K$ conversion of these γ-rays were observed as short tracks starting at the origin of some of the γ-ray conversion tracks.

Cloud-chamber experiments are described by T. W. Bonner which show that there are two groups of neutrons from the nuclear reaction: $^2H + {}^2H \rightarrow {}^3He + {}^1n$. The low-energy group is produced in about 15 per cent of the disintegrations. The interpretation of these experiments is that a low-energy neutron is emitted whenever an excited helium nucleus of mass 3 is formed.

Stereoscopic photomicrographs showing a cosmic ray burst of about a hundred particles on a photographic plate with thick emulsion exposed to the action of cosmic rays are submitted by A. Jdanoff. Assuming that the particles are protons, the energy of the burst would exceed 200 Mev.

The optical extinction phenomena, exhibited by the arrangement of hydroxyapatite crystallites in dental enamel suggested by X-ray examination, have been calculated by J. Thewlis; they correspond closely, for both longitudinal and transverse sections of prisma, with those actually observed.

J. Mariani presents an application of non-Euclidean geometry to microscopic space-time occupied by elementary particles as an explanation of their radius and spin.

J. S. Huxley, C. S. Webb and A. T. Best record the existence of a state of 'torpidity' or reversible poikilothermy in birds. Fully torpid humming-birds become completely rigid and apparently poikilothermous, with no perceptible respiratory movements. Recovery takes 10–35 minutes. Torpidity has been noted both in fresh-caught and captive humming-birds, and a similar but less specialized condition in colies (*Colius*). It appears to be an adaptation promoting survival in unfavourable conditions.

M. B. Crane and P. T. Thomas report that diploid species of *Rubus* reproduce sexually; but in polyploid forms and species reproduction may be sexual, non-sexual (apomictic) or partly sexual and partly non-sexual, according to the species used as male in the pollination. They also report the occurrence of segregation within the apomictic progeny, and discuss these results in relation to the taxonomy of *Rubus*.

Mary J. Carroll finds that the respiratory stimulating factors obtained from Fleischmann's bakers' yeast, which stimulate the respiration of normal tissues, have no effect upon cancer tissue (spindle-cell carcinoma of the mammary gland). This difference in response may be due to a qualitative difference between normal and tumour tissue metabolism.

A method of demonstrating the presence of glycogen in *Amœba proteus* Y and of making useful permanent slides of this organism is described by Monica Taylor.

# Research Items

### Early Spread of Agriculture

H. J. E. PEAKE, having concluded that the cultivation of wheat (Emmer) first took place in Palestine (*Man*, March, 1939), now passes to consider the stages and directions of the diffusion of the cultivation of grain in the early world (*Man*, April, 1939). An early spread was to the south-west, where it is probable that the early Tasian civilization of the Nile cultivated grain, though there is no direct evidence; while their successors, the Badarians, were certainly cultivators. Both peoples were immigrants. From Palestine the cultivation of grain must have spread to Syria, where the people took to cultivating the inferior Einkorn, which apparently is associated with the Tell Halaf culture, extending from the neighbourhood of Aleppo to Arpachiyah on the outskirts of Nineveh. From this culture it may be assumed cultivation spread by way of Anatolia through the Troad to Thessaly, the Danube valley, the Rhine basin and ultimately to the lake villages of central Europe. From Palestine again, cultivation, passing along the Zagros range, appears early in Assyria, while in the early villages of the hills around Teheran, as early as Arpachiyah, it would seem that 'bread' wheat was produced by crossing. Thence it passed into Mesopotamia with the Al Ubaid culture, where it met the Emmer cultivation of Jemdet Nasr. From Persia, cultivation passed into Turkestan, where signs of wheat appear in a low level of Anau, and passing thence through Afghanistan it moved in two directions, on one hand appearing in the Indus civilization, on the other in the painted pottery culture of the early agricultural villages of China. The painted pottery culture of Tripolje of the south Russian 'black lands' has as yet produced no evidence, though it occurs in areas of derivative culture, reaching the Rhine and Switzerland. For western and northern Europe an origin is suggested, tracing it to a great maritime movement in the Early Minoan period which introduced agriculture along the coasts of western Europe and ultimately reached Denmark, which was also reached by bread wheat from the Ukraine through the Baltic.

### Religion of the Serbian Gypsies

ALEXANDER PETROVIĆ, investigating the origin and character of the religion of the Serbian gypsies (*J. Gypsy-Lore Soc.*, Ser. 3, 18, 2–3; 1939), finds a clue in the gypsy language, differentiating the 'new' religion from the 'old', according as belief is that of those who do, or do not, speak Serb. The 'new' religion of the Serb-speaking gypsies has borrowed concepts from Serbian belief. Thus the Romani *del*, by which the gypsy expresses everything that is above man, has come to be the equivalent of *Bog*, the Serbian popular concept of God as "an old man with white hair who lives above the clouds in heaven"; while *dji*, which to the gypsies originally meant the centre of everything, as, for example, the inside of the abdomen, or the heart of a fruit or a tree "most precious, most beautiful, most sweet", is used to translate the Serbian *duša* "the soul", which goes out of a man when he dies. *Kar*, however, meaning both *penis*, and "man", or "male", in addition to its anatomical sense, in which a high or abnormal degree of development is thought to bring good luck in marriage and otherwise, is used of phallic emblems made of the protective blackthorn, or failing this of wood, which bring good luck when concealed in the roof of a house or in a bed, and are worshipped or addressed in prayer by women, asking for good luck. This emblem is also found among the Serbs, but for sorcery or a love spell. Old women alone know its use, and pass on the knowledge to one another. There is no connexion between the two beliefs, unless of a common Indo-European heritage; but the gypsy belief, in conjunction with the evidence of language, points to worship of the procreative principle as the original form of gypsy religion, formulated possibly in their original home in India, where the cult of the *lingam* is found.

### A Spreading Factor in Snake Venoms

F. DURAN-REYNALS (*J. Exp. Med.*, 69, 69; 1939) has carried out investigations to determine whether the venom of poisonous snakes contains a factor capable of increasing tissue and blood permeability. He found that the venom of various species of snakes differed considerably in the power to spread Indian ink through the skin and apparently did so independently of its toxicity. The spreading power was greatest in the Viperidæ (rattlesnake) and relatively scanty in the venom of the Colubridæ proteroglypha (cobra). Extracts of the supralabial glands of harmless snakes contained only negligible amounts of the spreading factor. Rattlesnake venom heated at 65°–100° lost a large proportion of its toxicity but retained the ability to spread Indian ink. Antivenine serum inactivated both the toxic and spreading factors of venom.

### Vertebræ in a Fossil Crossopterygian Fish

FOR some years the ancestors of the earliest amphibians (Stegocephalia) have been sought among the Devonian Crossopterygian fishes. The skull and limbs of Stegocephalia have been compared especially with those of the Crossopterygian *Eusthenopteron*, which is found well preserved in the Upper Devonian rocks of Scaumenac Bay, Province of Quebec, Canada. A newly described specimen of *Eusthenopteron* now permits satisfactory comparisons to be made also with the vertebræ (W. K. Gregory, H. Rockwell and F. G. Evans, *J. Paleontol.*, 13, No. 1, 126–129, Jan. 1939). In the earliest known Stegocephalia, each vertebral centrum consists of two successive bony rings, an intercentrum bearing the neural and hæmal arches, and a pleurocentrum without arches (the 'embolomerous' arrangement). It now appears that in *Eusthenopteron* the intercentrum occurs as a delicate bony ring consisting of separate right and left halves in contact above and below. This intercentrum is separated from the next by an equally wide vacant space, which is closed at the top by a very small bone. The alternating vacant space, therefore, was probably occupied by cartilage, and

if this became ossified it would form a pleurocentrum to complete a vertebra like that of the earliest Stegocephalia. The comparison is indeed interesting and may be significant.

### Labradorite-Oranite

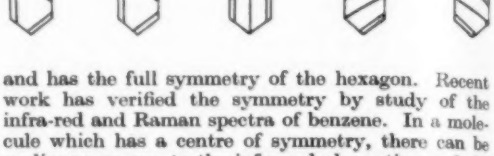
FELSPAR phenocrysts in the diabase-porphyry of Mount Devon in Missouri contain large amounts of potash, and for this reason the mineral has been referred to oranite, an intergrowth of orthoclase and lime-rich plagioclase, while the rock itself has been distinguished from other diabasic rocks as devonite. Goldich and Muilenburg (*Amer. J. Sci.*, **237**, 130; 1939) have made a detailed study of the rock and its minerals and they are able to show that the large phenocrysts represent labradorite which has been hydrothermally altered, with introduction of potash, to form sericite. It is pointed out that labradorite-oranites *may* exist as the result of normal crystallization from a magma, but that no good examples appear to be known. Chemical analysis alone is clearly not sufficient to establish the existence of oranite, unless it is definitely known that the mineral is unaltered. The authors reiterate their earlier conclusion that the use of the rock name 'devonite' should be discontinued. At its type locality the rock so-called is simply a hydrothermally altered diabase-porphyry.

### Structure of Iron Enneacarbonyl

ALTHOUGH some tentative structures have been proposed for the more complicated metal carbonyls, they have not been supported by any very convincing experimental evidence. The structure of $Fe_2(CO)_9$ has now been determined by X-ray analysis by H. M. Powell and R. V. G. Ewens (*J. Chem. Soc.*, 286; 1939), and the result is quite different from that previously suggested. The molecular formula is $Fe_2(CO)_9$. It is found that each iron atom is linked to three terminal carbonyl groups and the two iron atoms are joined by three carbonyl bridges $(CO)_3$ $Fe(CO)_3$ $Fe(CO)_3$. The ends of the molecule are formed by three $Fe \leftarrow C \equiv O$ groups which are linear, but the three intermediate groups are not linear and function as $>C=O$, each carbon being attached to two iron atoms and attached to oxygen by a double bond. The two iron atoms are formally ferric and the substance might be expected to show a paramagnetism corresponding to two unpaired electrons. Actually it is diamagnetic. This is explained as due to the complete coupling of the electron spins (not necessarily by bond formation) owing to the close approach of the iron atoms, which are only 2·46 A. apart.

### The Structure of Benzene

LAST year's Bakerian Lecture by C. K. Ingold (*Proc. Roy. Soc.*, **169**, 150) was devoted to recent work on the structure of benzene. Any solution to this problem must account for the great stability of benzene and for the approximately plane ring structure shown by X-rays and by electron diffraction. The electronic theory of valency explains chemical bonds in terms of the superposition of the wave functions of atoms, which may be expressed as the freedom of the electrons to exchange places. This freedom of exchange lowers the energy of the system and gives rise to binding forces. An extension of the theory explains 'mesomerism'. When there are two differently bound forms of a molecule, the possibility of transition from one to the other is expressed by the superposition of two wave functions, and it may be shown that the mixed or 'mesomeric' state has a lower energy and a greater stability than either of the separate configurations. On this view, benzene is a mesomeric combination of



and has the full symmetry of the hexagon. Recent work has verified the symmetry by study of the infra-red and Raman spectra of benzene. In a molecule which has a centre of symmetry, there can be no lines common to the infra-red absorption and the Raman differences. The coincidences which had been reported for benzene vapour were found to be spurious, and due to liquid benzene in which the symmetry of the molecules is distorted by intermolecular forces. The vibrations of a benzene ring in which the symmetry of the molecule was modified by the substitution of deuterium for some of the hydrogen atoms were considered in detail, and found to agree well with the observed Raman and infra-red spectra.

### Ozone in the Upper Atmosphere

AN account of observations of ozone in the upper atmosphere made in North-East Land (in latitude 80° 23′ N.) at the base of the Oxford University Arctic Expedition, 1935–36, by R. A. Hamilton, entitled "High Latitude Ozone Measurements", was read before the Royal Meteorological Society on March 15. The measurements involved the determination of the amount of absorption of ultra-violet light in the spectrum of the Pole Star, by examination with a photometer of the spectra obtained with a quartz spectrograph. The densities of the spectra for wave-lengths of 3290 A. and 3092 A. were compared with the same densities on an image on the plate of a source of light the intensity of which varied along the image in a known manner. The required constants for the actual computation of the amount of the ozone were obtained by carrying out a similar experiment at Oxford at night when the amount of ozone had been measured on the previous and following days by the standard method. Corrections had to be applied for the errors due to fogging of the plates by the light of the aurora borealis. The mean error of a determination was found to be of the order of magnitude of $30 \times 10^{-3}$ cm., but the day-to-day fluctuations were much greater than this. The day-to-day fluctuations were, moreover, found to be very much larger than those observed in lower latitudes. A point of resemblance with what has been observed in all other latitudes was to be found in an autumnal decline in the amount of ozone. This continued throughout the winter, while there was a sudden rise in spring. A table of comparisons between the measurements made in January and February 1936 with similar measurements made by Dr. Tönsberg at Tromsö (latitude 69° 50′ N.) was shown. Observations were made on the same day at both places on only three occasions, but a large ozone figure was found on one of these occasions (January 17) at both places.

# The State and Unemployment

THE report of the Commissioner for the Special Areas in England and Wales for the year ended September 30, 1938*, indicates that the activities of the Department have been devoted to continuing work previously begun and making extended efforts to attract new industries to the areas.

Very satisfactory progress appears to have been made with the trading estates at Team Valley and Treforest, and the Commissioner has also provided factories on other sites, including several which can accommodate many undertakings, such as the Solway Estate, Maryport, and the sites at Pallion, St. Helens, Auckland and Dowlais. Some sites were originally acquired for the clearance of industrial ruins, and at the end of September twenty factories were occupied or in preparation in certain districts outside the estates, where the problem of unemployment has been most intractable, including the Rhondda Valley, Dowlais, south-west Durham and Cleator, west Cumberland. In addition to the powers to provide factories and to offer inducements, the assistance which is available towards capital, either in the form of a loan or by taking up shares or debentures, has been of special value in establishing new industries. For this there are available the Nuffield Trust, the Special Areas Reconstruction Association and the Treasury Fund. The Commissioner considers that the time is too short to draw any final conclusions regarding the value of the provisions of the Special Areas (Amendment) Act, 1937, for the encouragement of new undertakings in the Special Areas, which have now been exercised for sixteen months. Even, however, if some help to the Special Areas is immediately forthcoming as a result of restrictions on the growth of London, he considers it would be a mistake to reduce the powers at present available for encouraging new industrial activity in these areas. They continue to present a serious working problem of a population in excess of the present employment capacity, which cannot be solved by short-term methods.

The report shows that between mid-1936 and mid-1937 the population of the Special Areas in England and Wales fell by 42,000 as compared with 38,000 in the preceding twelve months and 23,500 in 1934-5. The total fall in the three years was 3·6 per cent and this fall continues to be due wholly to migration from the Special Areas, although the natural increase in population, due to excess of births over deaths, is still steadily decreasing in rate, having fallen by 43 per cent in seven years, as compared with 25 per cent in the rest of the country. In the Durham and Tyneside Special Area the rate of decrease of population was not so great as in the previous year, but in the other two main Special Areas it was greater.

The Special Areas have been affected by the general trade recession to a slightly less degree than the rest of the country, the percentage of unemployment during the year increasing from 21·4 to 24·3, mainly in South Wales and Durham. Although the increase in the whole of Great Britain was two and one half times as great as in the Special Areas, the percentage of unemployment in the latter remains nearly twice as high as it is for the country as a whole—24·3 as against 13·6. A striking feature of the present situation is the increase of 34 per cent in the number of men, aged 18–20 years, unemployed, between May, 1937 and May, 1938 as compared with a decrease of 42 per cent in this group between May, 1936 and May, 1937. This increase is attributed partly to a decline in transference. With regard to the prolonged unemployment which characterizes the Special Areas as compared with the rest of the country, although the position has improved since 1935, the proportion of long-unemployed men remains approximately as it was three years ago, three and one-half times as high as in the rest of the country.

The Commissioner points out that the main difficulty in solving the unemployment problem in the areas has been due to the fact that in the past the areas have been dependent largely on one or two heavy industries, such as coal-mining, iron and steel and shipbuilding. There has been comparatively little variety in the types of employment provided and the demand has been predominantly for male labour. A good deal of the new industrial development has been of the light industry type in which the proportion of female labour is higher, and accordingly it has not had quite the same effect in increasing the employment of men. The development of new industries has, however, also led to the provision of training facilities to assist unemployed persons to obtain work in their own districts in industries new to the locality.

The position of the local government services has also improved and when a number of hospital schemes have been completed, the health services should be substantially up to the level of the services in other parts of the country. Especially in the north-eastern area, progress has been made in clearing away the industrial ruins of past days. In regard to social work, the need for continuing the provision of holidays by the sea for children on the grounds of health is stressed, as well as for school camps and assisting the settlements. Once again special emphasis is laid on the importance of preventing demoralization among the young men, and of bringing them within range of useful occupation and opportunities of ordinary wage-earning employment. The Commissioner considers that the measures available to him under the Special Areas Act and the valuable training and transference facilities afforded by the Ministry of Labour are not wholly adequate to meet the need. In his view it would be reasonable in selected cases to require applications for unemployment assistance, as a condition of the receipt of a cash payment, to attend one of the instructional centres or physical fitness classes organized by the Ministry of Labour. Unless such an applicant could show good cause, he should be confronted with a choice between compliance with a reasonable condition if he is to continue to receive cash payments, and one form of assistance which would contain an element of deterrence. The Commissioner simultaneously, however, stresses the importance of further efforts to devise schemes to provide new

* Report of the Commissioner for the Special Areas in England and Wales for the Year ended 30th September 1938. (Cmd. 5896.) Pp. vii+120. (London: H.M. Stationery Office, 1938.) 2s. net.

openings for the able-bodied unemployed, particularly young men.

The Commissioner for the Special Areas in Scotland* also insists on the necessity for a long view. A boom in the heavy industries is little more than a temporary relief, and the object should be to change the unstable industrial equilibrium by introducing as many secondary industries as possible. He concludes that no solution which aims at getting the older men back into ordinary wage-earning employment can wholly succeed. Despite its inherent difficulty, some form of sub-economic development must be provided. The absence of any serious attempt to co-ordinate the activities of the various social service organizations in Scotland is criticized, and the Commissioner considers that further expenditure from the Special Areas Fund would be fully justified if it welded into a strong national body the various organizations at present doing fine work in most difficult circumstances. In regard to industrial development, the Commissioner suggests that more might be done to help new and experimental processes, and that a scheme designed to foster new enterprise in the area should include encouragement of such processes, even if in the nature of things their ultimate success was bound to be problematical.

* Report of the Commissioner for the Special Areas in Scotland for the period 1st September 1937 to 30th September 1938. (Cmd. 5905.) Pp. viii+88. (London: H.M. Stationery Office, 1938.) 1s. 6d. net.

# International Congress of Tropical and Sub-Tropical Agriculture

THE eighth International Congress of Tropical and Sub-Tropical Agriculture was held at Tripoli during March 13–17, under the presidency of Prof. Le Plae, honorary general director of agriculture to the Colonies' Ministry, Belgium, in the unavoidable absence of Prof. Franco Angelini, secretary-general of the International Federation of Technical Agriculturists (F.I.T.A.). Delegates from Italy, France, Belgium, Holland, Poland, Germany, Bulgaria and other countries attended the Congress, and Great Britain was represented by Sir John Russell, as chief Government delegate, and by Sir Arthur Hill.

The Congress was opened by H.E. Marshal Balbo, Governor-General of Libya, who also presided at the concluding meeting. At the opening meeting, papers were presented by Prof. Armando Maugini on "European Colonization and Native Agriculture in Tropical and Sub-Tropical Countries", by Count Edmond de Warren on "Agricultural Production of the Warm Countries" and by Prof. Le Plae on the "Professional Preparation of Native Agriculturists through Compulsory Instruction". The Congress then broke up into five sections. The first dealt with the possibilities of agriculture in tropical and sub-tropical countries, Sir John Russell being one of the presidents of this section. In the second section papers were read on agricultural problems relating to ecology, meteorology, erosion, irrigation and dry culture; while the third section dealt with various economic problems such as credit, labour, co-operation and marketing.

The fourth section was in two parts, one devoted to vegetable products, of which Sir Arthur Hill was one of the presidents. Numerous papers dealing with cotton, sugar-cane, rubber, olives and vines in North Africa, citrus, etc., were presented, and also papers dealing with forestry. In the other subsection, papers relating to animal products were read.

The fifth section was devoted to insect and fungus pests of cultivated crops.

Visits were paid to the Agricultural and Zoo-technical Experiment Station near Tripoli where fine new laboratories have just been completed; the grounds contain a very representative collection of citrus species and varieties, and of vines, almonds and other trees of economic value. The citrus, including grapefruit, were bearing large crops.

Of particular interest were the visits to the new villages of Crispi, Michele Bianchi and Oliveti, which have been recently built. Crispi, only some four months old, is situated in a seemingly desert plain and consists of some 333 farms with a civic centre where the church, town hall with cinema, hospital, school and co-operative store are arranged around a central square. The farms allotted to each colonist are 37–120 acres in extent according to the locality, part being irrigated for the growing of wheat, lucerne, cotton, etc., the rest being dry-farmed with olive and almond trees and vines.

Crispi with its new white houses in this sandy spot was not a prepossessing sight, but a visit to Bianchi and Oliveti, nearly three years old, was a revelation of the possibilities of irrigation and good cultivation, since at the start they were founded on sites as sandy and barren as Crispi.

At these two villages, the olive and almond trees were flourishing and beginning to bear, and the irrigated crops were in very good condition—a great tribute to the good work of the Italian colonists from the Venetian plain and to the foresight of the organizers of these remarkable developments. No doubt in Roman times much of this North African 'desert' country was fertile, else such magnificent cities as Leptis Magna and Sabratha would not have been founded.

The new colonist is provided with his house, sheds and farm on trust, together with the equipment and livestock. After a short time on a fixed salary, he is placed on a crop-sharing basis for about five years and in the sixth year he becomes full owner of the farm and assumes direct management. At the end of nine years, when he has paid one-third of his debt, the colonist becomes full owner of his farm. The whole debt is expected to be paid off before the end of the thirty-fifth year.

This eighth Congress was admirably organized by Dr. Gioacchino Dallari, colonial adviser of the Fascist Confederation of Land Workers, and his staff. The majority of delegates were conveyed from Genoa, Naples or Messina in the S.S. *Roma*, a fine cruiser of 30,000 tons which served as their headquarters during the Congress.

It was suggested that the Congress in 1941 might be held in England.

# Localization of Activity in the Brain

IN his Ferrier Lecture to the Royal Society, Prof. E. D. Adrian (*Proc. Roy. Soc.*, B, **126**, 433; 1939) traces the development of the electro-physiological methods of investigation and analysis of the activities of the cerebral cortex from the discovery of the electrical excitability of the brain by Fritsch and Hitzig in 1870. This discovery led to Ferrier's classical work on cerebral localization, the main facts of which have never been seriously questioned, and, indirectly, to the modern method of study of cerebral function, the recording and analysis of the waves of electrical potential, which are the inevitable accompaniment of cortical activity.

Berger's observation that the electrical activity of the cortex could be detected through the unopened skull came at a time when the range of electrical technique was increasing enormously, and the result has been a great and sudden increase in the volume of work published on the subject. The great beauty of the method is that it allows a study of the activity of the whole cortex, and not merely in "the arrival and departure platforms"; but it has the inevitable difficulty of the interpretation of the records from an organ which, by its very nature, never responds twice in precisely the same way. Thus, the local electrical response, which has been shown to follow the arrival of sensory impulses, is related in size, not to the stimulus, but to the previous history of the cortical area on which it falls. In fact, the mechanism of the various types of facilitation which are in constant evidence in the cortex is one of the most fascinating problems.

Some details of the spread of activity in the cortex can be studied in the response of the sleeping, or narcotized, brain to the arrival of a sensory message, but a simpler, because more easily controlled, method is the investigation of the response of the cortex to a direct electrical stimulus. Such a stimulus evokes a reaction locally, not unlike that in response to a sensory message. In the surrounding areas it has two distinct effects: the direct spread of the excited state and a diffuse general increase in excitability, which reveals itself, after repeated stimulation, in the wide spreading of waves of considerable electrical potential, very like those which occur in man during epileptiform convulsions.

It is evident that the cerebral cortex responds readily to sensory messages, and it is therefore difficult to define what is meant by the 'spontaneous' activity of the brain. It seems clear, however, that although the response is to some degree controlled by the character and size of the message reaching it, the final pattern of the cortical activity is determined by the structure of the particular region and by its history. However hopeless may seem the task of analysing the activity of the human brain, these new methods offer some hope, at least, of understanding the mechanisms which exist in it, and from which its behaviour is eventually synthesized.

# The Spens Report and General Science

## Discussion by the Association of Women Science Teachers

THE Association of Women Science Teachers held an extraordinary general meeting on March 4 at St. Paul's Girls' School, by kind permission of the Governors and the High Mistress, to consider: (1) the Spens Report in its relation to science in the curriculum; and (2) the Report on General Science, Part 2, recently published by the Science Masters' Association.

The Spens Report sees the value of "the natural sciences when vitally taught" and it emphasizes the need for general interest, but it indicates that this might require less time than a formal study. The idea that the wider study of science might require less time was questioned by the meeting, but members were in agreement that there is still room for pruning and taking stock of the topics which are included, so that the science teaching might instil the desire "to search for truth, goodness and beauty" and give some understanding of the part played in the modern world by the forces of science. Some felt that the emphasis on English subjects as the core of the curriculum might subordinate science, but all were agreed that all subjects had an important part to play in the teaching of English.

There was considerable variation in opinion as to the time which should be allowed to science, but it was felt that the time suggested by the Spens Report is adequate for a general view, but where greater detail and depth of knowledge are desired, more time is necessary. There are, however, the 'pool periods' for which science specialists can make a claim. There was general agreement that specialization at an early age is not desirable. It was felt by many that the school child of to-day is over-taught, and that there is a definite need for leisure in school time so that there might be an opportunity for reading; for this to be of real value the school must possess a good library.

The Spens Report also emphasizes the need for good demonstrations as against excessive practical work on the part of the pupil. There was general agreement that, to produce such demonstrations, both time and good laboratory assistants are essential; it was also felt that demonstrations might be overdone at the expense of the pupil, who obtains satisfaction from the activity involved in practical work. Care is required to keep the balance between demonstration and individual work by the pupils.

The general feeling of the meeting on the Spens Report can be summed up in the words of a member, who said: "Here we have the core of something which is going to give the mass of our child population

something that will stay by them", and for this "we have to sacrifice things we think valuable". Surely the end which is desired makes this worth while.

In the discussion on general science which followed, the question of the teaching of general science by one mistress and as one subject, and not by individual specialists, was raised. Some members felt that in the two years preceding School Certificate the syllabus should be taught by specialists in the individual branches. The majority of the members present appeared to consider that more was gained when it is taught by one, and that freshness of outlook, saving of time and greater correlation between the branches might result.

Miss Casswell, headmistress of the Edgbaston High School for Girls, gave an interesting report on the minimum syllabus for general science, which is based on the minimum syllabus of the Association of Assistant Mistresses and of the Association of Women Science Teachers, and on the extended syllabus which is based on the Science Masters' Association's Report on General Science, Part 2. Both of these new syllabuses have been drawn up by the Joint Matriculation Board of the Northern Universities. The minimum syllabus does not have a bias in any particular direction, and it tries to get a unity of science through a study of forms of energy, the material environment and the plants and animals of the environment. The syllabus is such that in ordinary circumstances there should be time for revision and for the introduction of other material which will give the individual teachers freedom of choice. The second paper naturally requires more time, and there would necessarily be opportunity for greater selection and deeper study of sections of the syllabus in which there might be greater interest, and this would involve effort to suit the work to the special circumstances and environment of the school.

Throughout the meeting it could be seen that there was a real and deep appreciation by science teachers of the need to make the teaching such that "it should reveal the influence of scientific thought and achievement in the evolution of our present-day civilisation, and that it should indicate its possibilities, for good and evil, in the future of the human race".

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# Petroleum and World Politics

THE importance of the geographical distribution of the heavy minerals around the North and South Atlantic Oceans was stressed in NATURE of January 28, p. 169. It is well to remember, however, that the world distribution of petroleum is also closely related both to the arts of peace and to the horrors of modern warfare. In the present temper of the world, any non-belligerent nation which possesses reserves of petroleum is in danger of finding itself involved in serious political complications. This is especially true of those States of South America which are believed to possess the world's largest reserves of petroleum. In this connexion, some remarks of Dr. D. Rey Vercesi and Dr. Juan H. Caorsi of Montevideo, in a paper of recent date[1], seem worthy of wider attention.

The authors observe that it is the policy of the more advanced nations of the world to exploit for their own principal benefit the supplies of petroleum in the less-advanced countries of South America. Since 1936, also, it has become the policy of the United States, which is the largest producer as well as the largest consumer of petroleum, to conserve its own resources, which are calculated to be sufficient for about thirty years at the present rate of consumption, and to import large quantities of crude oil from foreign, mainly South American, sources. This attitude of the greater Powers is causing much searching of heart among South American peoples, who see their national resources being rapidly depleted and perhaps to some extent wasted elsewhere in the frantic rush of the modern world. Such stirrings of national spirit help to explain the recent happenings in Mexico and other States.

The authors place the world production of crude oil in 1937 at about two thousand million barrels, and give the following figures of production in the principal producing countries in thousands of barrels (each barrel = 42 gall.)

| | | | |
|---|---|---|---|
| U.S.A. .. .. | 1,278,000 | Mexico .. .. | 46,700 |
| U.S.S.R. .. | 200,000 | Iraq .. .. | 30,700 |
| Venezuela .. | 185,300 | Colombia .. | 20,200 |
| Iran .. .. | 78,100 | Peru .. .. | 17,700 |
| Dutch Indies .. | 54,900 | Trinidad .. .. | 15,600 |
| Rumania .. | 52,000 | Argentine .. | 15,300 |

They quote General Serrigny's recent estimate in round figures of exportation in tons from the four principal geographical producing regions:

| | |
|---|---|
| North America .. .. | 21,000,000 |
| South America .. .. | 28,000,000 |
| East Mediterranean .. | 12,000,000 |
| Orient .. .. .. | 14,000,000 |
| Total .. | 75,000,000 |

Of this total, about 33 million tons go to Europe.

The authors remark that since the necessities of a European war in which the United States might be involved would greatly increase the demand for petroleum and the non-belligerent countries would not diminish their consumption, it would be necessary to increase world production perhaps two or three times, and supposing that supplies from North America, the east Mediterranean and the Orient were for various reasons unobtainable or unreliable, on South America would fall from necessity or choice the principal charge of meeting the increased demand. The South American States, and especially Venezuela and Colombia, would thus be required to supply the demands of the belligerents.

It is clear that an international situation of great gravity might easily arise, and it is good to know that the younger and clearer minds in South America are already at work upon the problem. The authors urge the necessity of co-operation between the South American States themselves and collaboration in a spirit of peace and good will with the industrialized nations of the world for the general good of humanity.

J. D. FALCONER.

[1] "Politica del Petroleo a seguirse por los paises sudamericanos". A.N.C.A.P., Montevideo, 1938.

# Seismology at Kew Observatory

THE most complete seismological equipment in the British Isles is at Kew Observatory, and thanks largely to the enterprise of its superintendent, Dr. F. J. W. Whipple, the performance of this has recently been vastly improved. Dr. A. W. Lee, the seismologist at Kew, has now written an account of the new installation (Meteorological Office, Geophysical Memoirs No. 78, sixth number, 9. London: H.M. Stationery Office, 1939. 2*s*.).

The three Galitzin seismographs, originally presented to Eskdalemuir Observatory by the late Sir Arthur Schuster, were, after transference to Kew, placed on a massive concrete pillar in the basement of the main building but isolated from it. These instruments were greatly influenced by the wind, and it was found by experiment with a Milne-Shaw instrument borrowed from the Science Museum, that the effect was not due to direct draughts on the instruments but to the rocking of the whole building and the surrounding subsoil by the wind; hence the entirely new building to house the seismographs, which was ready for occupation early in 1937. The two Wood-Anderson seismographs constructed at Kew (1933 and 1935) were transferred in February, the Galitzin horizontal pendulums in April, and the vertical Galitzin in September 1937.

The new building, which has two rooms at the same level, is situated about 100 yd. south-south-west of the main observatory building, and has its floor 5 ft. below the level of the surrounding paddock. The ceiling is covered by soil and turfed, the level of the turf being about 5 ft. above the surroundings. The whole is made to withstand the weather, and the temperature of the ventilated rooms is thermostatically controlled.

The south room, 20 ft. by 15 ft., contains the seismographs on concrete pillars built directly on the floor, and the north room, 10 ft. by 15 ft., contains the galvanometers and recording drum for the Galitzin pendulums on slate slabs cemented to concrete pillars. The timing is by a Hope Jones synchronome (No. 1901) standard clock which is arranged to give time breaks of 2 sec. at the minute and 4 sec. at the hour accurate to within a few tenths of a second, on recording paper fixed to an electrically driven drum. The rate is 15 mm. per minute. The small Wood-Anderson instruments have a static magnification of about 700 : 1 and the instruments at Kew are adjusted to have a free period of 2·5 sec. with a damping ratio of approximately 20 : 1. Both north-south and east-west components are made to register on the same drum in a similar manner to the three Galitzin instruments.

It is confidently expected that in addition to welcome minor improvements, the changes will have obtained for the Kew seismograms that freedom from wind effect and more uniform drum rate than with the separate clockwork drives which was so much desired.

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# The First Imperial Veterinary Conference

THE Imperial Agricultural Research Conference which was held in London in 1927 recommended that certain specialized imperial agricultural bureaux should be established, and as a result ten bureaux are now in operation. Two important events have since taken place. Following the Ottawa Conference of 1932, the Imperial Committee on Economic Consultation and Co-operation, in 1933, examined and reported on *inter alia* the work and functions of these bureaux; and in 1936 the British Commonwealth Scientific Conference met.

The First Imperial Veterinary Conference is one of the many important developments of the Imperial Agricultural Research Conference of 1927. It was held in London in August last and was attended by delegates from the United Kingdom, from each of the Dominions, and from Colonial Territories*.

The Conference was opened by Mr. F. L. McDougall, a former chairman of the Council of the Imperial Agricultural Bureau, who pointed out the economic importance of the livestock industry to the several territories of the British Empire, and directed attention to the results that have been achieved in the control of animal disease. The sessions of the Conference were devoted to consideration of the working of the Imperial Bureau of Animal Health and to discussion on certain disease subjects of outstanding interest. The deputy director read a report on the work of the Bureau. At the present stage of its development, the maintenance of the indexing and abstracting services is the main activity. *Index Veterianarius*, issued half-yearly, is a classified subject and author catalogue dealing with about 10,000 references per annum. The *Veterinary Bulletin*, issued monthly, is devoted to abstracts, of which about 3,500 appear annually. The development of a review service is imminent. A special committee was appointed by the Conference to report on the Bureau.

At the sessions devoted to disease subjects, "Foot-and-Mouth Disease", "Gaseous Lymphadenitis of Sheep", "Virus Diseases of Animals", "Laryngotracheitis", "Infectious Bronchitis and Corzya of Poultry", "Blowflies of Sheep", "Fowl Paralysis", "Bovine Mastitis", "Johne's Disease" and "Chronic Bovine Hæmaturia" were discussed.

Resolutions were passed emphasizing the importance of the Imperial Bureau of Animal Health and recommending certain developments in its activities, on the importance of work concerning a reliable diagnostic agent for Johne's disease, and on the danger of using certain prophylactic measures for the control of foot-and-mouth disease and some other virus diseases.

* Report of the First Imperial Veterinary Conference, 15th–18th August 1938. Pp. 97. (Weybridge: Imperial Bureau of Animal Health, 1938.) 5*s*.

## Science News a Century Ago

### Exploration of the White Nile by Steam Vessel

AMONG the papers read to the Royal Geographical Society on April 22, 1839, was one by A. T. Holroyd entitled "On the Practicability of Exploring the Sources of the White Nile with a Steam Vessel". In his recent journey to Sennar and Kordofan, said the author, his attention was directed to one of the great desiderata in African geography, namely, the exploring of the sources of the Bahr el Abyad. If a steam boat left Cairo in July, drawing not more than two feet of water, it might with care pass all cataracts between Cairo and Khartoum. "I mentioned the subject of passing the cataracts to Mr. Perring, an eminent civil engineer in the employ of Mohammed Alí Pasha who kindly made a drawing of a steamer calculated for a steam expedition." The proposal was to leave Cairo in July, get to Berber in September and remain there until the end of the rainy season. An express was to be sent ahead to Khartoum to prepare for the arrival of the boat. From that place, the steamer would proceed up the Bahr el Abyad and it would be probably found that six months would suffice to survey both branches of the river. The vessel would return to Berber and await the rising of the Nile before proceeding to Cairo.

### Fossils and Shells from Canada

AT a meeting of the Geological Society held on April 24, 1839, Lyell read some "Remarks on some Fossils and recent Shells collected by Capt. Bayfield, R.N., in Canada". Several eminent conchologists having observed that in the English crag there are certain shells which indicate a somewhat colder climate than that which prevails in our latitudes, and it having been supposed that a similar difference may be deduced, but with greater certainty, from shells found in the newer Pliocene strata in Scotland and Ireland, Lyell had been induced to examine with great care the collection sent home by Capt. Bayfield, which consisted partly of fossils procured from the most modern tertiary deposits bordering the Gulf of St. Lawrence, and partly of recent Testacea from the Gulf itself.

### The Smithsonian Bequest

IN a long communication on science, education and other matters to the *Athenæum* of April 27, 1839, a United States correspondent said: "The topic now is the appropriation of Smithson's (English) bequest. The amount is half a million of dollars. Government have invited our distinguished men to offer plans for the proposed institution, and many have been given in. Some want a national university of the highest European order, in Washington on Jefferson's model. Others propose courses of lectures, and various other things. One of the most remarkable of these schemes is that of a German, who wishes for a grand national agricultural institute at the seat of government, of course, with the idea, I presume, that agriculture is the great interest of this nation, and yet one in which we are grossly deficient. . . . He would have a farm large enough for all experiments to be tried, and all systems exhibited."

James Smithson (1765–1829), F.R.S., at his death had left more than £100,000 to the United States for founding a Smithsonian Institution at Washington for the increase and diffusion of knowledge. The Institution was finally inaugurated in 1846.

## Societies and Academies

### London

**Royal Society** (*Proc.*, A, **170**, 300–450; 1939).

A. C. CUTHBERTSON, G. GEE and E. K. RIDEAL: Polymerization of vinyl acetate.

D. R. BATES, R. A. BUCKINGHAM, H. S. W. MASSEY and J. J. UNWIN: Dissociation, recombination and attachment processes in the upper atmosphere. (2) Rate of recombination.

D. SHOENBERG: Magnetic properties of bismuth. (3) Further measurements on the de Haas–van Alphen effect.

A. WIGGLESWORTH: Flexure and torsion of an internally cracked shaft.

L. A. WIGGLESWORTH and A. C. STEVENSON: Flexure and torsion of cylinders with cross-sections bounded by orthogonal circular arcs.

E. L. MCBAIN: Diffusion of long-chain sulphonic acids.

J. G. DAUNT and K. MENDELSSOHN: Transfer effect in liquid HeII. (1) The transfer phenomena. (2) Properties of the transfer film.

### Paris

**Academy of Sciences** (*C.R.*, **208**, 853–952, March 20, 1939).

A. LACROIX: Dacitic pumices floating on the ocean between the Fijis, the New Hebrides and New Caledonia.

L. LAPICQUE: A so-called active principle of curare. Carneiro described results contradicting the classical findings; they were due to experimental mistakes.

F. GRANDJEAN: Asymmetric distribution of accessory organs.

R. FOSSE: Ureogenesis and purine nitrogen metabolism in plants.

E. CHATTON and MLLE. J. SEGUELA: Genetic continuity of the *cinétome* in some ciliate Hypotriches.

J. FAVARD: Determination of some convex surfaces.

A. ROSENBLATT: Problems of the calculus of variations in the case of simple integrals in which the extremities of the line of integration are variable on some curves with singular points.

E. VESSIOT: Reducibility of automorph systems of which the associated group is simply transitive.

S. BERGMANN and J. MARCINKIEWICZ: Limiting values of functions of two complex variables.

R. TREMBLOT: The spectroscopic triple star *H.R.* 6497.

MLLE. P. FÉVRIER: Indiscernibility of corpuscles. Indiscernibility involves indeterminism.

G. BIBEN: Characteristics of the equations of the photon.

A. PROCA and S. GOUDSMIT: Mass of the meson and other elementary particles.

F.-J. TABOURY: Polarographic study of polished unchangeable electrodes: analogy of structure of a Beilby surface and of a liquid mercury surface.

A. MARCELIN: Maximum distance of distinct visibility through a disturbed medium. Coloration of a liquid and intensity of light are without influence.

G. DESTRIAU and LOUDETTE: Influence of the electric field on the form of the emission bands in electro-photoluminescence.

A. GUINIER: Diffusion of X-rays by crystals and microcyostalline bodies.

J. SOLOMON: The notion of superficial tension in nuclear physics.

C. HAENNY and A. ROSENBERG: Emission of neutrons during the experimental disruption of the uranium nucleus: possibility of chain reaction. Each neutron absorbed can lead to the emission of several neutrons, and experimentally an increase of 20 per cent in the neutron effect on an ionization chamber has been produced.

T. URBANSKY and RYCHTER: Contact action of a heated metallic surface on some explosive substances.

G. WÉTROFF: The equilibrium $P_4 \rightleftharpoons 2P_2$ in phosphorus vapour.

*(To be continued.)*

## Moscow

**Academy of Sciences (*C.R.*, 20, Nos. 7–8, 1938).**

N. G. TOUGANOFF: Lines on a surface, the geodetic torsion and the normal curvature of which are in a linear relation.

W. TURKIN and P. DUBUQUE: Structure of simple groups.

P. DUBUQUE: A theorem, containing the theorems of Frobenius, of Weisner and of Turkin, on the number of elements of a given order in a group.

V. LUKCHIN: Deformation of closed and open rotation surfaces with negative curvature.

S. FINIKOFF: Pair of surfaces in which the asymptotes of one correspond to a conjugate system of another, and the homologous tangents intersect.

N. S. IVANOVA: (1) Soft bundle-producing constituent of cosmic radiation. (2) Hard constituent of cosmic radiation and the Rossi curve.

J. L. ZELMANOV: Liquefaction of helium by means of the Joule-Thomson effect.

A. T. DADAIAN and E. J. PUMPER: Measurement of the absorption of ultra-sonic waves in air and in argon.

I. KIRVALIDZE: Spectral distribution of the absorption coefficient in X-irradiated sodium chloride crystals in the case of disappearance of inner tensions.

F. A. KOROLEV: Application of Töppler's method to the measurement of ultra-sound absorption in air.

V. KONDRATIEW: Absorption spectrum and lifetime of the carbon sulphide radical.

V. I. MALYSHEV: Investigation of the frequency of the OH-group in binary mixtures by means of combination dispersion.

A. MIGDAL: Scattering of neutrons in ferromagnetics.

M. A. ILJINSKY, L. G. GINDIN and V. A. KASAKOVA: Oxidation of alkyl-anthracenes, alkyl-anthraquinones and their derivatives. (1) Oxidation with chromic anhydride of β-methyl-anthraquinone to anthraquinone-β-carboxylic acid. (2) Oxidation of β-methyl-anthraquinone with chromic anhydrides to anthraquinone-β-carboxylic acid as influenced by water.

L. G. GINDIN: Investigation of the corrosion of metals by non-electrolytes.

O. CH. SCARRE and A. E. BRODSKY: Concentration of the heavy isotope of oxygen and isotopic analysis of water.

V. I. NAZAROV and A. V. NIKOLAJEV: Application of Kurnakov's pyrometer in the investigation of the gelatinization of potato starch.

A. V. NIKOLAJEV: A study of stereoisomery and of the isomerization of some complex platinum compounds by the method of heating curves. Enlarging the crystals of metallic platinum.

A. M. RUBINSTEIN: Investigation of the complex components of platinum and α- and β-aminopyridine.

B. M. MIKHAILOV and N. G. ČERNOVA: Synthesis of 10-alkyl derivatives of 9-methyl-1.2-benzanthracene.

O. M. CHERNTSOV: Reaction to distinguish lævulose from glucose.

E. L. KRINOV: Pavlodar stony meteorite.

V. N. KRESTOVNIKOV and D. M. RAUSER-CHERNOUSOVA: Foraminifera from the transitional beds between the Devonian and the Carboniferous (Etroeungt zone) of Kazakhstan, South Urals and Samarskaya Luka.

O. N. SOROKINA: Role of amphidiploids and other balanced types in crosses between widely separated forms.

M. GOLDHAUSEN: Interspecific hybrids in water-melons.

K. I. PANGALO: Living ancestors of cultivated water-melons.

F. E. REIMERS: (1) Stage-development in different biological groups of lettuce (*Lactuca sativa* var. *capitata*). (2) Change of the "sign of photoperiodic reaction" in turnips.

V. G. ALEXANDROV and O. G. ALEXANDROVA: Endosperm nucleus and its role in filling and ripening of grains of cereals.

V. J. RUDENSKAJA: Anatomical premises for breeding large-rooted forms of 'kok-saghyz'.

G. I. AZIMOV and A. D. ALTMAN: Various parts of the anterior lobe of the pituitary body and physiology of lactation.

A. V. RUMJANTSEV: Growth of embryonal tissue *in vitro* as influenced by an excess of chlorides (sodium, potassium, calcium).

A. A. WOITKEWITSCH: The action of the substance from various zones of the anterior hypophysis lobe in the chick.

## Rome

**National Academy of the Lincei (*Atti*, 28, 117–175; 1938).**

G. ARMELLINI: Fundamental problems of the cosmogony and Newton's law (3).

G. SILVA: Keplerian motions and theory of the annual aberration of light.

Q. MAJORANA: (1) Further researches on the action of light on thin metallic films. (2) Action of periodically interrupted light on thin gold films.

G. GHERARDELLI: An observation on the linear complexes of spaces.

A. ROSENBLATT: Unequal single-valued functions in the unitary circle.

L. SOLAINI: Influence of internal orientation errors in photogrammetric restoring.

F. P. MAZZA and C. MIGLIARDI: Some *p*-aminobenzene sulphonyl-α-aminoacids and their derivatives.

C. ARNAUDI: Researches on the acidifying micro-organisms of ensilaged fodders.

A. CORRADETTI: Attempt to reconstruct the general cycle of plasmodians in the vertebrate host.

G. MARTINO and A. ALIBRANDI: New observations on the conditional reflexes of blinking (for acoustic stimuli).

A. VATOVA: Hydrographic observations on the lakes of Italian East Africa.

# Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

## Monday, April 24

VICTORIA INSTITUTE (at the Central Hall, Westminster, S.W.1), at 4.30.—Mrs. Walter Maunders: "The History of India, as Reflected in the Astronomy and Meteorology in the Hymns of the Rig Veda".

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A. King: "The Imperial College Expedition to Jan Mayen, 1938".

## Tuesday, April 25

ST. MARY'S HOSPITAL, LONDON, W.2, at 5.—Prof. Wilfred Trotter, F.R.S.: "Has the Intellect a Function?"

## Wednesday, April 26

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. A. Hrdlička: "The Present Status of our Views on Human Evolution".*

## Thursday, April 27

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. P. M. S. Blackett, F.R.S.: "Cosmic Rays" (Kelvin Lecture).

## Friday, April 28

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. A. Hrdlička: "The Racial Fallacies and Realities of European Peoples".

ROYAL INSTITUTION, at 9.—Sir James Jeans, O.M., F.R.S.: "Tone Colour and Electrical Music".

## Saturday, April 29

GILBERT WHITE FELLOWSHIP (at the Art-workers' Guild, 6 Queen Square, Southampton Row, W.C.1), at 2.30.—Annual General Meeting.

R. A. Smith: "New Light on Pre-historic Monuments" (Presidential Address).

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U.S. NATIONAL ACADEMY OF SCIENCES, April 24–25. Annual Meeting to be held at Washington.

April 24, at 8.30: Sir William Bragg, Pres.R.S.: "History in the Archives of the Royal Society" (Pilgrim Trust Lecture).*

BRITISH MEDICAL ASSOCIATION, April 27–29. National Conference on "Wider Aspects of Nutrition".

April 28, at 8.15.—Prof. V. H. Mottram: "Nutrition and the Public Health" (Sir Charles Hastings Public Lecture).*

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# Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN CHEMISTRY in the Newport Technical College—The Director of Education, Education Offices, Charles Street, Newport, Mon. (April 28).

ASSISTANT LECTURER IN ENGINEERING SUBJECTS in the West Hartlepool Technical College—The Chief Education Officer, Education Offices, West Hartlepool (April 28).

LECTURER IN HYGIENE AND PUBLIC HEALTH in the Battersea Polytechnic, London, S.W.11—The Principal (April 29).

JUNIOR INVESTIGATOR OF STRENGTH OF MATERIALS to the British Non-Ferrous Metals Research Association, Euston Street, London, N.W.1—The Secretary (May 1).

RESEARCH OFFICER for the Technical Advisory Committee of the North-East Development Board, 162 Northumberland Street, Newcastle-on-Tyne (May 1).

LECTURER IN ELECTRICAL ENGINEERING AND PHYSICS and LECTURER IN MECHANICAL ENGINEERING AND MATHEMATICS in the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough (May 6).

ASSISTANT LECTURER IN BOTANY in University College, Swansea—The Registrar (May 15).

# Reports and other Publications

(*not included in the monthly Books Supplement*)

## Great Britain and Ireland

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 10, No. 3, December 1938. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. v+189–269. (London: H.M. Stationery Office.) 4*s.* 6*d.* net. [233

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 24: Scientific Results of the Voyage of S.Y. *Scotia*, 1902–04: The Crinoidea. By Prof. C. Vaney and D. Dilwyn John. Pp. 661–672+1 plate. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.). 2*s.* [243

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia in 1937. Survey prepared by Dr. B. P. Uvarov and Miss W. Milnthorpe. Pp. 64+9 maps. (London: H.M. Stationery Office.) 3*s.* net. [253

New Forest Association. Annual Report and Statement of Accounts, 1938. Pp. 20+8 plates. (Brockenhurst: New Forest Association.) [253

Department of Scientific and Industrial Research. Common Pests of Grain and other Stored Produce. Pp. iv+18 (8 plates). (London: H.M. Stationery Office.) 3*d.* net. [273

## Other Countries

Suomen Geodeettisen Laitoksen Julkaisuja. No. 27: Formeln und Tabellen zur Berechnung der Nivellitischen Refraktion. Von T. J. Kukkamäki. Pp. 18. (Helsinki: Finnischen Geodätischen Institutes.) [203

Denkschriften der Schweizerischen Naturforschenden Gesellschaft, Band 73, Abh. 1: Central Himalaya; Geological Observations of the Swiss Expedition, 1936. By Arnold Heim and August Gansser. Pp. xvi+246+26 plates. (Zürich: Gebrüder Fretz A.G.). [203

Svenska Hydrografisk-Biologiska Kommissionen. Skrifter, Ny serie. Hydrografi 14: On the Angular Distribution of Submarine Daylight and on the Total Submarine Illumination. By Nils G. Johnson and Gösta Liljequist. Pp. 16. Fyrskeppsundersökning år 1936. Pp. 46. (Göteborg: Svenska Hydrografisk-Biologiska Kommissionen.) [213

Field Museum of Natural History. Botanical Series, Vol. 20, No. 1: The Myxophyceæ of Maryland. By Francis Drouet. (Publication 439.) Pp. 14. (Chicago: Field Museum of Natural History.) 15 cents. [233

University of Denver: Department of Anthropology. Archæological Survey Series. Eleventh Report: Petroglyphs of North Central New Mexico. By E. B. Renaud. Pp. 58+26 plates. (Denver, Colo.: University of Denver.) [233

Annual Report of the American Telephone and Telegraph Company for 1938. Pp. ii+38. (New York and London: American Telephone and Telegraph Co.) [233

Ministry of Public Works, Egypt: Physical Department. The Nile Basin. By Dr. H. E. Hurst and Dr. P. Phillips. Supplement to Vol. 2: Measured Discharges of the Nile and its Tributaries from 1929 to 1932. (Physical Department Paper No. 33.) Pp. vii+736. (Cairo: Government Press.) P.T. 50; 10*s.* [233

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 216: The United States Coast and Geodetic Survey: its Work in Surveying and Charting the Waters of the United States and Possessions, Geodetic Control Surveys, and other Activities. Pp. 12+2 plates. (Washington, D.C.: Government Printing Office.) [243

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bind 119, Nr. 9: Investigations on the Copepod Fauna in East Greenland Waters. By P. Jesperson. Pp. 106. 4.75 kr. Bind 121, Nr. 3: The Zoology of East Greenland—Copepods. By P. Jesperson. Pp. 66. 3.00 kr. (København: C. A. Reitzels Forlag.) [273

Smithsonian Miscellaneous Collections. Vol. 98, No. 4: Five New Races of Birds from Venezuela. By Alexander Wetmore. (Publication 3528.) Pp. 8. (Washington, D.C.: Smithsonian Institution.) [273

Proceedings of the United States National Museum. Vol. 86, No. 3048: Revision of the Beetles of the Melolonthine Subgenus Phytalus of the United States. By Lawrence W. Saylor. Pp. 157–168+plates 9–10. (Washington, D.C.: Government Printing Office.) [273

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 20: Education and the Civil Service in New York City. By Prof. Wallace S. Sayre and Milton Mandell. (Project in Research in Universities.) Pp. vii+79. (Washington, D.C.: Government Printing Office.) 15 cents. [273

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 21: Investigations on the Cold Storage of Mangoes. By Dr. G. S. Cheema, Dr. D. V. Karmarkar and B. M. Joshi. Pp. ii+69+5 plates. 3.12 rupees; 6*s.* Miscellaneous Bulletin No. 23: The Cold Storage of Fruits and Vegetables. By Dr. G. S. Cheema and Dr. D. V. Karmarkar. Pp. ii+15+4 plates. 10 annas; 1*s.* (Delhi: Manager of Publications.) [273

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## Catalogues, etc.

P. J. Kipp and Zonen Galvanometers. (List 'Galvo 38'). Pp. 8. (London: W. Edwards and Co.)

Rare Books: including Early English Works, Economics, Incunabula, Medical, Science, Transport, also Manuscripts and Autographs. (Catalogue No. 637.) Pp. 76. (London: Francis Edwards, Ltd.)

Calendar for 1939–40. ("Girl" Series.) (Manchester: Metropolitan-Vickers Electrical Co., Ltd.)